APRIL 1994
ISSUE #403
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CAN $3.95
A WGI Publication
International Edition

73 Amateur Radio Today

MOTORCYCLE MOBILE!

Half-Kilowatt For 2 Meters

Build a Simple SWL Receiver

73 Reviews

Lightning Bolt Quad

Diamond X2200A

Quickyagi Software

The IC-Δ100H Takes The Magic Beyond 3 Wishes!

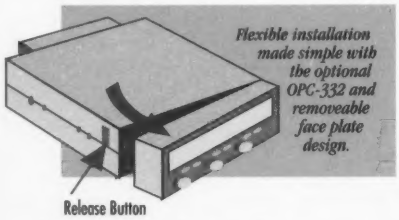
Exclusive Triple Band Capability

- Three independent band units for 2 M, 440 MHz and 1.2 GHz operation (simultaneous receive).
- Three independent displays can freely select the desired band unit.
- Each display indicates S/RF, volume and squelch levels.
- Each display is controlled by a separate volume and tuning knob.
- Select from 3 external speaker jacks.

8 POSSIBLE COMBINATIONS!		
1	2	3
2M	440MHZ	1.2GHZ
2M	440MHZ	440MHZ
2M	2M	1.2GHZ
2M	2M	440MHZ
440MHZ	440MHZ	1.2GHZ
440MHZ	440MHZ	440MHZ
440MHZ	2M	1.2GHZ
440MHZ	2M	440MHZ

More than a tri-band radio, the IC-Δ100H gives you true freedom of choice!

- No removal or installation of additional band units required.
- Each operating band has a separate antenna connector to enable duplexer/triplexer use without any mismatching antenna loss (not one common antenna for multi-signal, one band operation like you see in competitive models).
- Cross band double duplex (transmit on one band while receiving on two others) and full crossband duplex (transmit on one band and receive on another) is possible. The one-touch PTT enables telephone-like conversations without having to continually press PTT.



Remote Installation Options

- **One Body –** install as a complete unit.
- **Separate –** detach the front panel and mount each separately (see illustration).
- **Remote –** Mount the main body in the trunk (OPC-333 and OPC-335 req.).

Incredible Performance

- AFC-RIT, AFC-VXO, manual RIT and manual VXO modes to compensate for "off frequency" of the Tx station (1.2 GHz).
- High Sensitivity – less than .16μV.
- Double-conversion superhetrodyne receiver system.
- More than 2.4 W audio output power.

Memory Bank System

- 642 memory channels organized in two separate banks* (very convenient for two ham families).

Options	Bank/User #1			Bank/User #2			TOTAL
Bank	#1	#2	#3	#1	#2	#3	
Normal*	100	100	100	100	100	100	600
Scan Edge	6	6	6	6	6	6	36
Call	1	1	1	1	1	1	6
Total IC-Δ100H Memory Channels:							642

The memory bank system can even be customized for "his" and "hers" operation!

- Priority Watch – Scans one (or more) memory channels per band while operating on a VFO frequency.
- Transfer call or memory channel contents to VFO. Particularly useful when searching for signals around a memory channel frequency and for recalling the offset frequency, tone frequency, etc.
- 14 DTMF autodial memories for autopatching, accessing repeaters and controlling other equipment, etc.

* Stores operating frequency, duplex direction, offset frequency, subaudible tone frequency, encode on/off, tone squelch on/off and skip information.

Microphone Remote Controls

- Power On/Off
- Select Main Band
- Change Operating Band
- Volume Adjust
- Squelch Adjust
- Mode Select
- Duplex Select
- Frequency Select
- Memory Channel Select
- Mute Bands
- Scan or Priority Watch
- Pager On/Off
- Code Squelch
- Tone, Tone Squelch
- Pocket Beep On/Off
- AFC On/Off
- Attenuator On/Off
- Set Mode
- DTMF Auto or Manual
- Operating Freq. Announce (with opt. UT-66 synth.)
- Write VFO Contents to Memory or Call Channel
- Lock All Mic Keys or Keyboard Only

A multi-function keyboard with complete control over the IC-Δ100H.

The beep tones for each band are different and distinguishable so you can keep your eyes on the road.

Over 22 functions are at your fingertips with the IC-Δ100's unique microphone keyboard (see chart above)!

IC-Δ100H Triple Band Mobile Transceiver (shown with the optional OPC-332)

Other Great Features

- External remote control via another transceiver (UT-55 required)
- Tri, dual or mono band operation
- Sub band access/mute/busy beep functions
- Optional pocket beep and tone squelch
- Opt. pager/code squelch
- Tone encoder built in
- Multiple scans

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Δ1001143Y

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FIND FREQUENCIES FAST
With the new, high sensitivity, ultra-fast, Auto Trigger & Hold **STARTEK** frequency counters. Increase readability distance with the new Band Pass Filters. All products made in USA.

AUTO TRIGGER & HOLD
Now, for the first time, available on inexpensive, portable counters with our new *ATH ™* Series. This feature is the most significant improvement ever made to the pocket sized counters! It allows "Hands Free" operation to automatically *read & hold* a signal as quick as 80ms or 8% of a second.

New ATH™ Series
Say goodbye to random counting & false readings with the ATH™ Series

TA-90 Antenna
(priced separately)

Introducing NEW ATH-50

HP-400
Band Pass Filter

ATH-15
1-1500 MHZ

ATH-30
1-2800 MHZ
One-Shot Feature

ATH-50
5 Hz to 2800 MHZ
One-Shot Feature

Ultra Bright Display

Signal Strength Bar Graph Works on Every Range

Low Battery Indicator

Size 4"h x 3.5"w x 1"d Aluminum Cabinets (No Self Tap Screws)

ATH SERIES FEATURES INCLUDE:
- Easy to use – simple controls
- Ultra fast response time
- Extra BRIGHT LED digits
- 3-5 hour battery operation
- Automatic clean dropout
- Maximized sensitivity, <1mV typical
- Signal strength Bar Graph
- 2 ranges – 6 fast gate times
- 9-12V auto-polarity power jack
- *StarCab™* aluminum cabinet

Ni-Cads and A/C Charger INCLUDED with ALL Models

In Stock... Same Day Shipment!

ATH, Ultra High Sensitivity Frequency Counters			
ATH-15	1-1500 MHZ, High speed	$199.	$236.
ATH-30	1-2800 MHZ, High speed, one shot	259.	239.
ATH-50	5 Hz to 2800 MHZ, one shot	289.	339.
HST-15	Optional 0.2 PPM TCXO High Accuracy Timebase (installed)	100.	125.
Economy Frequency Counter			
1350	1-1300 MHZ, 10 HZ Res. 3 gate times, Hold switch	$119.	129.
Band Pass Filters			
Increase range or distance from a transmitter with a Band Pass Filter. <1 dB pass band insertion loss.			
LP-60	DC-60 MHZ Usage		$69.
HP-400	400-1500 MHZ Usage		69.
HP-800	800-2000 MHZ Usage		69.
BP-3	Above 3 filters *(SAVE $30)*	$177.	207.
Accessories			
A *CC-90*	Case for all models		12.
B *TA-90*	Telescope BNC antenna		12.
C *TA-90-L*	Telescope elbow antenna		16.
D *RD-150*	150 MHZ rubber duck		16.
E *RD-2750*	27-50 MHZ rubber duck		28.
F *RD-800*	800 MHZ rubber duck		29.
G *M-207-IC*	Interface cable for MFJ-207		10.
H *P-110*	200 MHZ, 1x, 10x probe		39.
J *LP-22*	Lo-Pass, audio usage probe		25.
K *DC-10*	Direct, 50 OHM probe		20.

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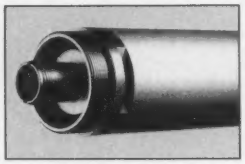
●DC GROUNDED ●STAINLESS HARDWARE

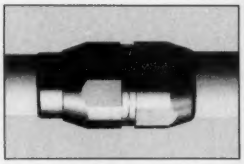
X-500HNA

RUGGEDIZED BASE/ REPEATER ANTENNA



COAX CONNECTION AT BASE END

HEAVY DUTY BASE/ RADIAL ASSEMBLY



STRONG JOINT COUPLINGS

X series

MODEL	BAND(MHz)	GAIN(dBd/dBi)	WATTS	CON.	SWR BANDWIDTH (MHz)
X-50A	144/440	4.5/7.2	200	UHF	5.6	135
X-200A	144/440	6.0/8.0	200	UHF	8.3	112
X-300A	144/440	6.5/9.0	200	UHF	10.2	112
X-510NA	144/440	8.3/11.7	200	N	17.2	90
X-510MA	144/440	8.3/11.7	200	UHF	17.0	90
X-500HNA	144/440	8.3/11.7	200	N	17.8	90+
X-700HA	144/440	9.3/13.0	200	UHF	24.0	90
X-2200A	144/222	6.0/7.8	150	UHF	11.5	112
X-3200A	144/222/440	6.0/7.8/8:0	100/200	N	10.5	112
X-6000A	144/440/1240	6.5/9.0/10.0	100/100/60	N	10.5	112

147MHz

445MHz

RADIATION PATTERNS FOR X-500HNA/X-500MA/X-510NA

BAND: 144=144 - 148MHz. 222=222 - 225MHz. 420=420 - 430MHz.
430=430 - 440MHz. 440=440 - 450MHz. 1240=1240 - 1300MHz.
* X510NJ :144 - 147 / 430 -440MHz

X510

GH/F/U&V series

MODEL	BAND(MHz)	GAIN(dBd)	WATTS	CON.	SWR BANDWIDTH (MHz)
DP-GH62	50	6.0	200	UHF	21.0	78
F-22A	144	6.7	200	UHF	10.5	112
F-23A	144	7.8	200	UHF	15.0	90
F-142A	222	5.5	200	UHF	6.0	110
F-718A*	440	11.5	250	N	15.0	110
F-1230A	1240	13.5	100	N	10.5	90
U-200A	440/1240	8.3/11.7	100	N	5.9	135
U-300A	440/1240	8.6/13.2	100	N	8.3	110
U-5000A	144/440/1240	4.5/8.3/11.7	100	N	5.9	135
V-2000A	50/144/440	2.1/6.2/8.4	150	UHF	8.3	110

*F-718A:440 - 450MHz, F-718J:430 - 440MHz, F-718L:420 - 430MHz

U-300A 440MHz

F-22

U-300A 1200MHz

F22 U5000 GH62

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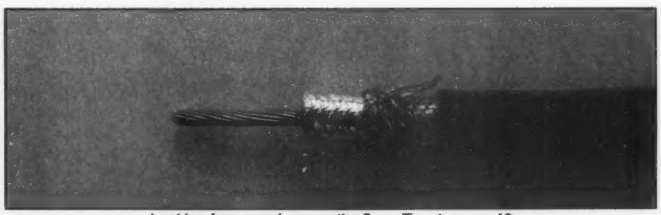

Looking for a good connection? . . . Turn to page 48.

DEPARTMENTS

FEEDBACK... FEEDBACK!

It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK card on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best. And then we will draw one Feedback card each month for a free subscription to *73*.

On the cover: Why not combine ham radio with motorcycling? It's easy to do! Turn to "Motorcycle Mobile!" on page 10.

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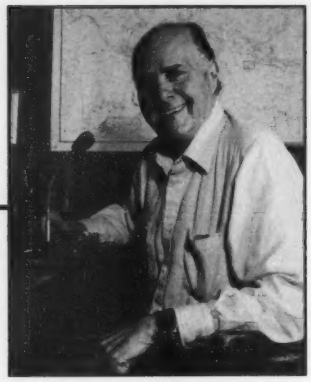
Contract: By straining your eyes to read these tiny words you are hereby required to take a friendly pill. The next time you hear a newcomer on the air, give that extra effort to make him or her feel welcome.

NEVER SAY DIE

Wayne Green W2NSD/1



Good Science, Bad Science

Have you gotten sucked in on some of the phony science scares? Like the acid rain baloney? Alar? How about the ozone hole panic or greenhouse effect? Nuclear winter? Since you've decided to elect lawyers with no science background to run our country, our science-ignorant Congress has been throwing billions at one ecoscam after another, urged on by a scientifically illiterate media and public. You should pay more attention to your old Uncle Wayne, who has been pooh-poohing these alarums and excursions for years.

At one time we were going to be overpopulated to starvation, bringing on a movement to limit families to two children. Remember zero population growth (ZPG)? And we were going to run out of oil by the end of the century. We were losing our topsoil. Our croplands were being paved over and we'd starve. We were using up our ground water. We're poisoning the oceans. We're killing the whales. Nuclear war would wipe everyone out. The ice age cometh. Doom! And how about that virtually science-free Earth Summit last year in Rio and the dreaded freon and PCBs? All ecological disaster phony baloney. But very expensive baloney.

We're still being warned about pesticides, non-renewable resources, pollution, genetic engineering plagues, toxic wastes, landfills, and endangered species. Oh yes, and some of our reason-challenged religious fanatics are expecting the end of the world any day now. For the exact date, check with the Seventh-Day Adventists the next time they come to your door.

Yes, there have been some legitimate environmental concerns, but separating them from the spurious hasn't been one of our government's better accomplishments. In the last 30 years scores of new environmental laws have been enacted, complete with thousands of regulations. The government is spending over $130 billion this year on environmental regulation. The Environmental Protection Agency's budget has jumped 31% in the last four years and its staff has swelled by 23%. The federal budget for climate change research alone will be $1.4 billion this year! What a lovely piece of pork that one is! Pork you and I are paying for.

Presumably you're familiar with Veep Al Gore's environmental hysterics. I don't think he's ever seen an environmental scare that he didn't climb aboard and endorse.

60 Minutes does some fine investigative reporting, but every now and then they screw up seriously—like with the Alar scare and the accelerating Audis. Both turned out to be complete hooey, but you'd never know it from watching the program and waiting for an apology.

The really big money in all this is that collected by advocacy groups from concerned citizens, whipped into a frenzy of concern by the media. No amount of failed prophecies seems to discourage people from taking the next cry of doom seriously and sending checks.

Yes, some species are becoming extinct—just as millions have in the past. That's part of the survival of the fittest deal, which we accept as a rule of nature (God?). I haven't any problem with our trying to protect species which man is decimating, as long as we don't have the government doing it at our expense. The government, and that mainly means Congress, has an unblemished record of screwing up everything it does and costing us a bundle to do it.

The one thing nobody has figured out yet is how to stop us from re-electing the same crooks to Congress again and again. You're the one who voted in the crook who is wasting your money and screwing up your country for you.

Can anything be done about this mess? Of course, and it's not all that complicated. My recommendation is to get your state legislature to pass a law saying that any representative or senator from your state may not comment or vote on any legislation where he or she has a conflict of interest. A conflict would arise if any money or other benefits were received directly or indirectly from any party with an interest in said legislation. If other states passed similar laws this would cut off PAC and lobbying money, throwing tens of thousands of lobbyists out of work. It would give our politicians less money to spend on dirty-trick TV ads and maybe force them to come up with some proposed solutions to our problems instead of spending their campaigns astride fences.

The media are in love with doom and gloom. "Good news does not sell papers" is the old and true saw, so the worse they can make things appear, the more papers they'll sell, and the higher the TV ratings. But in view of the almost complete failure to happen of every scientific disaster we've been warned about, is there any way I can at least get you to be skeptical the next time some scientifically ignorant journalist cries wolf? And that, unfortunately includes some scientists who should know a lot better, such as astronomer Carl Sagan and his nuclear winter campaign. Shame on you, Carl!

"Can anything be done about this mess? Of course, and it's not all that complicated."

If you'd like to do some homework on this subject you could do worse than read *Ecoscam* by Ronald Baily; St. Martin's Press, 1993; 228p. Another book you'll enjoy is *Environmental Overkill* by Dixie Lee Ray; Regnery Gateway, 1993; 260p. Those'll give you more than enough to talk about on the air.

Those Pesky Anomalies

If you've been keeping up with your science basics you may have a vague grasp of how matter is put together. You know, all those atoms and stuff. Of course our scientists just couldn't leave things well enough alone—they had to go and try to take the atom apart. So they ended up with a growing mess of particles. Most stuff is made out of protons and electrons. And it's those pesky electrons which make it possible for us to have the displays in Las Vegas, and our radios.

Einstein made it bad enough, but then Planck and his lousy quantum theory really screwed up what had seemed pretty simple before that. Now, if you have kept up with the mess scientists have been making, you've got a rough concept of matter being made out of energy. This is how they came up with nuclear fission, and its practical application with the atom bomb and nuclear power plants. Then there's fusion, such as is keeping the sun going, and which peps up our atom bombs into fusion bombs. They're trying to harness the power of fusion, but not having any real success. Yet.

But the fact is that all this stuff around us is made up of atoms, and they're made up of energy. A whole big bunch of energy. What would be nice for us would be to find some way to tap into that energy, and be able to turn it on and off like a faucet. Now, while the cold fusion researchers have been having some amazing successes, there seem to be some other approaches which may allow us to tap into this energy. There are a number of hints on ways to tackle this. Scientists call these anomalies because they don't yet understand them and don't know how they work.

One way someone can make a billion or seven is to come up with a practical and inexpensive way to provide energy. It helps to be there first with something like that. That's the way Bill Gates got to be a billionaire—he had the first usable version of BASIC and sold it to the first microcomputer manufacturer—and then rode the wave from there on.

Hal Fox, in his December *New Energy News*, lists seven approaches to generating power that are being researched and show promise. Most of these are research projects that can be done on the cheap. It doesn't take $500 million a year the way they're spending on hot fusion. I've talked with experimenters who are spending more like $1,000 a year—and are having very serious positive results.

Pons and Fleischmann were pursuing an anomaly when they discovered that a mixture of palladium, deuterium, and lithium salts put out more power than was possible through any chemical reaction. Most scientists dislike anomalies and tend to dismiss them just by calling them anomalies. But for others anomalies are the key to discovering new things.

One of the more exciting aspects of my getting interested in cold fusion has been my meeting with scientists with open minds. What a pleasure! And what an enormous number of things there are that need to be investigated. There was a move to close the patent office a hundred years ago. Let's not close it yet. In fact, let's put on some pressure for it to be more in

Continued on page 92

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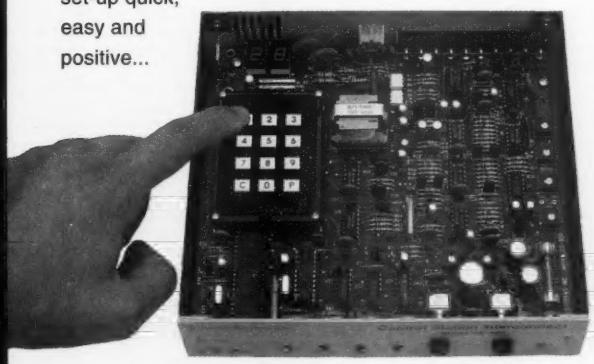
Our microprocessor controlled interconnects patch your FM base station radio to your phone line and allow you to initiate and receive phone calls in your mobile or HT without assistance.

Only **CSI** interconnects offer important user friendly features such as Memory Speed-dialing, Last Number Redial and a built-in Programming keyboard with companion digital display which makes user set-up quick, easy and positive...



All features are fully user programmable: • Speed-dial memories • Single or multi-digit access code. • Secret toll override access code • Toll restrict numbers and sequences • Regenerated tone or pulse dialout • Ringout on 1-9 ring • Line in use detect • Call waiting • CW ID • Hookflash • Activity & Timeout timers... And More !

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Private Patch V

Private Patch V is a multi-mode interconnect that offers four user selectable modes: 1. Enhanced Sampling 2. VOX Simplex 3. Semi-Duplex 4.Repeater Maker. A 90 memory speed-dialer and remote base mode are also included. Can be connected to the Mic and speaker jacks of any simplex transceiver when used in VOX simplex. Fully FCC and DOC approved. No other patch offers as many modes and features.

CS-900 Control Station Interconnect

NEW

The CS-900 is VOX activated and can be used simplex or through any remotely located repeater. The standard 1/2 Second Electronic Voice Delay totally eliminates syllable or word clipping and results in unsurpassed simplex performance. A 90 memory speed-dialer and Remote base mode are also included. The only required connections are to the Mic and Speaker jacks of your simplex transceiver. Fully FCC and DOC approved. This is the best deal going in a simplex patch!

CS-800 Full Duplex Interconnect

The CS-800 will operate Full or Semi duplex and also has a built-in Repeater Maker. The only required connections are to the Mic and Speaker jacks of your dual band transceiver. A 9 memory Speed-dialer is standard. Fully FCC and DOC approved. This is your best choice in a Full Duplex Interconnect with built-in Repeater Controller!

CS-700 Intelligent Interconnect

The CS-700 is for simplex operation and offers selectable VOX Enhanced or VOX Controlled Sampling. Sampling allows the mobile operator to have positive control at all times. The CS-700 requires an internal connection to the discriminator of your simplex transceiver. A 9 memory Speed dialer is standard. This is the best sampling patch in the business!

CD-1 Communications Decoder Unit

Decodes and displays all 50 CTCSS tones, 104 DCS codes and all 16 DTMF digits when connected to any scanner, receiver or service monitor. Extremely useful for service work or determining the correct codes to operate open repeaters and autopatches. DTMF sequences are displayed a second time, slowly just in case the real time digits were too fast to comprehend.

CIRCLE 12 ON READER SERVICE CARD

LETTERS

Number 2 on your Feedback card

From the Hamshack

Glen Gercken NØPNQ, St. Charles MO I have been reading your magazine from cover to cover for about three years now. I enjoy it very much and have wanted to write to you many times.

The letter from Fred Carmichael KD4ATW (December 1993) is like a carbon copy of me. I have experienced the very same problems that he has.

I wholeheartedly endorse what he has said about licensing without the code requirement. If a young person is interested in electronics today he will go into computers and not ham radio. Ham radio could offer avenues for development of greater types of communication if only the code requirement were dropped to attract these young, talented people. The bottom line is: Do we want these people in the computer world or the ham world with computers?

Glen—Your point is well taken; but don't give up hope. In the March 1994 issue of Radio Fun, *Dr. Joseph H. Taylor K1JT said that ham radio is* still *an excellent training ground for young scientists. Taylor won the 1993 Nobel Prize in physics and said amateur radio was key in launching his career.*

Taylor said that technical knowledge remains at the heart of amateur radio and he had no objection to the no-code license. The fact is that there are more choices available for our brightest young people today. Anything we can do to bring amateur radio into the 1990s would help to attract more of them into our hobby. It seems only a matter of time before the code test takes its rightful place in the museum between the buggy whips and the slide rules.—Charlie WA1RZW

Roman S. Makuch N2UCK, West Hurley NY In response to Randy KB7UIT's letter in the February 1994 issue, I also am a No-Code Tech. Instead of moaning and groaning about the FCC's insistence on requiring code to gain greater privileges, he should join a club and have one of the old-timers teach him. I have done that and will be attempting the 13 wpm element.

With the books that are published by numerous publishers giving the whole question pool, the written elements have been reduced to nothing more than an exercise in memorization. With my electronics background, I could probably pass the Extra Class element in my sleep. Getting a higher class license should be an achievement and not a joke.

By removing the code requirements, those who have advanced to higher licenses would have their accomplishments reduced to almost nothing.

If Randy ever decides to try some of the more difficult VHF techniques (eg. aurora propagation above 144 MHz), he will quickly find that without code he won't get through.

If the FCC reduces the code requirement to where it will be "so easy that it's just a nuisance," then they might as well just give out the licenses without testing at all.

Amateur radio is a challenging *hobby*, and as such I oppose reducing the requirements to the point where getting an amateur license becomes nothing more than a formality (read: JOKE!).

When people want to make something too easy and reduce other people's accomplishments it gets my dander up.

David S. Laustsen N3LHY, Doylestown PA 18901 *[Letter to Dean Frazier NH6XK, author of "My Longwire Antenna," 73* Amateur Radio Today, *September 1992.]* I read your article some time ago and decided to try to replicate it. My longwire is about 450 feet long and is made from #14AWG stranded insulated black wire from the local electrical shop. It has no coax—goes right out of the MFJ 986 tuner and out the second floor window—up to the top of a 50-foot tree and horizontal for about 400 feet. It is also an east/west wire with a slight bow in it. I have six radials for 160 meters and eight for 80 meters—all fanning out from the ground stake on the first floor. I run 100 watts RTTY/AMTOR/PACTOR and occasionally even SSB on all bands, and have no major RF problems even though I have a huge table of Macintosh stuff within four feet of the wire. I put a few snap-on RF chokes on some of the lines just to be sure, but no problem.

The performance of the antenna is very gratifying. People ask during QSOs, "Are you local?" or "Are you running a kilowatt?" I can break through pileups—almost with wild abandon—and I've worked just about everybody I can hear on the digital bands. Plotting out the major lobes of the antenna according to your tables, I can understand why I have had the DX performance that I have had.

This is a perfect antenna for those who have power lines in the front of the house—not enough room for a big doublet—and antenna restrictions on towers. We've had a lot of ice storms lately, and my friends on 2 meters were all complaining because they can't use their big beams—too much ice-induced SWR. I replied that the ice fell off my wire in about two hours, so I've been working DX while they're still trying to figure out how to get on the air!

I think that the end-fed longwire has had a bad "rap" from certain theoretical types who believe that all antennas must be balanced and have baluns—otherwise they have to be commercial beams.

Well, Dean, I don't know how much feedback you authors get on your articles, but my antenna is the best $20 worth of wire I've ever put up in the air—and I *thank you* for the idea. I recommend it highly.

I'm also a fan of *73* magazine and Wayne Green. He's amateur radio's voice of conscience and common sense.

Ted Stoforos N2MZJ, Long Island NY Wayne, PRINT THE HIV DEVICE SCHEMATIC! Use whatever disclaimers the shysters recommend, just do it. This is my (un)biased opinion. I do not have HIV, nor do I know anybody who has it.

The medical oligarchy and the drug monopoly need a good swift kick in the pants. Searching only for a chemical cure is their prerogative—after all, it's their money they're spending—but when they start interfering with independent research and other people's grants, that gets me mad.

As for losing a few pages of *73* next month, so be it. After all, some sacrifices must be made to keep the "free" in freedom of speech. Besides, would a man who has his ham radio budget planned for the next two years miss yet another product review? Would a ham who has four or five active projects on the bench miss another construction project? I think not. If challenging orthodoxy is the task, then a free press is the tool, and a well-informed, open-minded audience is the raw material.

You have the tools and the materials. Get to work. Of all people, you know how important it is to upset *this* apple cart. HIV is mankind's biggest and deadliest challenge yet. Your *73* readers and fellow hams (except the brain-dead) also know it. Of course, they will be right when they argue that *73* is not the correct place for this, but they're not thinking broadly enough. They're missing the point, because the very root of the problem is that the appropriate scientific journals won't publish this kind of unorthodox stuff.

I have read your rumblings for 2.5 years now, and you haven't turned me off yet. I get angry sometimes and rally with you (like now) and I try to do something about it. I get off my backside and get more involved in ham radio, build something, help someone, whatever. You help me to stay out of a rut, and remind me to reach out and to expect more from myself. Thank you and keep it up!

I read *73* from cover to cover, the very day it comes, and I occasionally read some of the other stuff between "Never Say Die" and "Random Output," too!

I agree that anyone who sues over a ham-related (non-business) dispute is scum. If you have to go to the courts to settle a problem involving your hobby, something is *very* wrong with your priorities.

When I first became a ham, I had trouble believing that any ham would deliberately sour another ham's enjoyment of the hobby by causing malicious interference and disrupting communications, but I hear all too much of it lately. Our weekly 2 meter ARES net gets jammed every now and then, and just last weekend somebody left a NON signal on our 440 repeater's input for over an hour. Stupid . . . you bet. But very motivating, for now I am trying my hand at direction finding antennas, phasing cable, deep nulls, step attenuators, and bunny hunting. I have read about this stuff for years and never tried any of it. It is hard to get it right—even though I know exactly what is *supposed* to happen, and how it is *supposed* to work, it often doesn't work, and never works the first time. It's a nice challenge, but I hope I don't *have* to DF too often.

Jim Rindfleisch Wayne, I'm an ex-broadcast engineer whose career has taken me in other directions. For years I've been reading your column and at last have decided to get off my duff and answer your request for information on what I do and don't like.

What I don't like: I'm a shortwave listener, not a ham, and for that reason feel compelled to offer a few observations from the outside looking in. First, it's a shame what has happened to the amateur bands, with the name-calling, carrier-throwing, profanity, VFO swishing and other types of behavior that not so long ago was restricted to the citizen's bands. As we all know, the radio spectrum is very crowded and space is valuable. If this resource is not well used it's not hard to imagine even more of the ham spectrum being given over to other more responsible users. The real shame about this is that I'm sure the offending operators are a minority that will eventually spoil the whole pie for everyone else. I'd hate to see the amateur bands restricted to a few noisy frequencies no one else wants because those who use it can't behave.

73 Amateur Radio Today is excellent, but in my opinion the best part is your column. I can't say I always agree, but your opinions are always well thought out.

Now, about equipment. Since I don't have a ham ticket I'm not sure I qualify, but as I do subscribe I'd like to pass on some observations on equipment. I use an ICOM R71A for shortwave and an ICOM R7000 for 'most everything else. Both radios have many hours on them and have never given me any trouble. They are as sensitive as the "professional" receivers and, with a computer interface and a wideband spectrum analyzer, much more useful. What I don't like is the extra converter that must be had for the computer interface with the R71. I guess into everyone's life some rain must fall.

In closing, I want to say thank you for what you've done for amateur radio, even from those of us who choose to "lurk" but not talk. Keep up the good work!

[Editor's Note: The following is a letter sent to the chairman of the Dayton Hamvention, a copy of which was sent to the 73 offices.]

Mr. Dave Grubb, Chairman
Dayton Hamvention
Dayton Amateur Radio Association, Inc.
Box 964
Dayton OH 45401-0964

Dear Dave,

I am one of a contingent of hams from Mobile that planned on flying to Dayton for the Hamvention. I had not planned on renting a car but anticipated using the shuttle bus service from the hotel as in prior years. I have just called your information number and learned that the Dayton Hamvention will not have shuttle buses running from the area hotels to the Hara Arena site this year. I also heard that the large parking area immediately adjacent to Hara Arena will not be available for parking this year. With the decrease in available parking, the decision to not have shuttle bus service to area hotels seems like a *very short-sighted decision*. The traffic problem at the Hamvention already is out of hand. With significantly decreased parking and no shuttle bus service from the hotels, I think you are headed for a disaster. I can tell you that if the Hamvention attendees have to spend 2 hours getting to the Arena and 2 hours getting back to their hotels each day you are going to have a *huge* controversy on your hands.

I respectfully submit that you reconsider the shuttle bus decision. I am looking to hear from you on this before I order our tickets for this year.

Yours truly,
S. Felton Mitchell, Jr.

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Low noise converters to receive vhf and uhf bands on a 10M receiver.
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- Input ranges avail: 50-52, 136-138, 144-146, 145-147, 146-148, 220-222, 222-224 MHz, 432-434, 435-437, 435.5-437.5, and 439.25 (to chan 3).

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XV2 for vhf and XV4 for uhf. Models to convert 10M ssb, cw, fm, etc. to 2M, 220, 222, 432, 435, and atv. 1W output. ***Kit only $89.*** PA's up to 45W available.

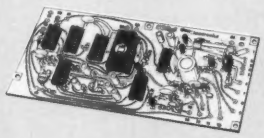
ACCESSORIES

Versatile DVR-1 DIGITAL VOICE RECORDER Module. As a **voice ID'er for repeaters**, records your voice, using the built-in microphone or external mic. Use with almost any repeater COR module. May also be used as a **contest caller** to play back one or more messages through your transmitter at the press of a switch. Used as a **radio notepad**, it can record the audio output of a receiver — up to 20 sec. of anything you might want to recall later. Play back as many times as you like through a small external speaker. Extensive manual tells how to use multiple messages and adapt for many applications. .....kit $59, w&t $99

TD-4 SELECTIVE CALLING Module. Versatile dtmf controller with 1 latching output. Mutes speaker until someone calls by sending your 4-digit tt code. Or use it with a long tt zero digit to alert anyone in club. Also may be used to control autopatch or other device. .....kit $49, w&t $79

COR-3 REPEATER CONTROLLER. Features adjustable tail and time-out timers, solid-state relay, courtesy beep, and local speaker amplifier. .....kit $39

CWID. Diode programmable any time in the field, adjustable tone, speed, and timer. .....kit $59



COR-4. Complete **COR and CWID** all on one board. CMOS logic for low power consumption. EPROM programmed; specify call. .....kit $79, w&t $129

NEW **COR-6. COR & Real-Voice ID** on one board. Digital ic records up to 20 seconds of your voice, using built-in or ext. mic. Can record multiple id messages. Tail and time-out timers, courtesy beep, solid-state relay to key transmitter. .....kit $99, w&t $149

TD-2 DTMF DECODER/CONTROLLER. 16 digits, toll-call restrictor, programmable. Can turn 5 functions on/off. .....kit $79, wired & tested $139

AP-3 AUTOPATCH. Use with above for repeater autopatch. Reverse patch and phone line remote control are std. .....kit $79, wired & tested $139

AP-2 SIMPLEX AUTOPATCH Timing Board. Use with above for simplex operation using a transceiver .....kit $39

TD-3 SUBAUDIBLE TONE DECODER/ENCODER. Adjustable for any tone. **Especially for repeaters,** with remote control activate/deactivate provisions ....kit $29, wired & tested $59

MO-202 FSK DATA MODULATOR & DE-202 FSK DEMODULATOR. Run up to 1200 baud digital signals through any fm transmitter & receiver with full handshakes. Radio-link computers, telemetry, etc. .... kit ea $39, w&t ea $69

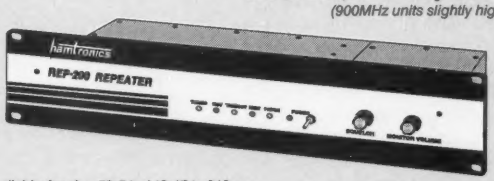
9600 BAUD DIGITAL RF LINKS. **Low-cost** packet networking system, consisting of MO-96 Modem and special versions of our 144, 220, or 450MHz FM Transmitters and Receivers. Interface directly with most TNC's. Fast, diode-switched PA's output 15 or 50W.

REP-200 REPEATER

A fully microprocessor-controlled repeater with autopatch and many versatile dtmf control features at less than you might pay for a bare-bones repeater or controller alone!

We don't skimp on rf modules, either! Check the features on R144 Receiver below, for instance: GaAs FET front-end, helical resonators, sharp crystal filters, hysteresis squelch.

Kit $1095; w&t only $1295!
(900MHz units slightly higher)



- Available for the 50-54, 143-174, 213-233, 420-475, 902-928 MHz bands.
- **FCC type accepted** for commercial service (150 & 450).
- Power out 20W 50-54MHz; 25W 143-174MHz; 15W 213-233 MHz; 10W uhf; 10W 902-928MHz.
- Available add-on PA's **up to 100W.**
- **Six courtesy beep types,** including two pleasant multi-tone bursts.
- **Open or closed access autopatch, toll-call restrict,** auto-disconnect.
- **Reverse Autopatch,** two types.
- **DTMF CONTROL:** over 45 functions can be controlled by 4-digit dtmf command, via radio or telephone.
- **Owner can inhibit** autopatch or repeater, enable either open or closed access for repeater or autopatch, and enable toll calls, reverse patch, kerchunk filter, site alarm, aux rcvr.
- Cw speed and tone, beep delay, tail timer, and courtesy beep type **can be changed at any time** by owner password protected dtmf commands.
- **Auxiliary receiver input** for control or **cross linking repeaters.**
- Color coded **LED's indicate status** of all major functions.
- 3½ inch aluminum rack panel, finished in eggshell white and black.

NEW **REP-200T Voice Message Repeater.** As above, except includes Digital Voice Recorder. Allows message up to 20 sec. to be **remotely recorded off the air** and played back at user request by DTMF command, or as a periodical voice id, or both. ..... **kit $1145, w&t only $1395**

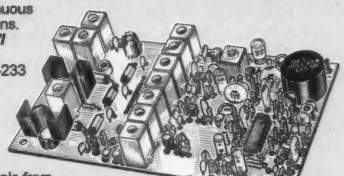
NEW **REP-200C Economy Repeater.** Like REP-200, except uses COR-6 Controller (no DTMF control or autopatch). Features **real-voice id** recorded with built-in microphone. ..... **Kit only $795, w&t $1095**

REP-200N Repeater. Want to use your ACC controller, etc.? No problem! We'll make you a repeater with rf modules only. ..... **Kit only $695, w&t $995**

XMTRS & RCVRS FOR REPEATERS, AUDIO & DIGITAL LINKS, TELEMETRY, ETC.

Also available in rf-tight enclosures, and with data modems.

FM EXCITERS: 2W continuous duty. TCXO & xtal oven options. ***FCC type accepted for com'l high band & uhf.***
- **TA51**: 50-54, 143-174, 213-233 MHz ...kit $109, w&t $189.
- **TA451**: 420-475 MHz ...kit $109, w&t $189.
- **TA901**: 902-928 MHz, (0.5W out); w&t $219.
- **VHF & UHF AMPLIFIERS.**
- For fm, ssb, atv. Output levels from 10W to 100W. Several models starting at $99.



FM RECEIVERS:
- **R144/R220 FM RECEIVERS** for 143-174 or 213-233 MHz. **GaAs FET** front end, 0.15uV sensitivity! Both crystal & ceramic if filters plus **helical resonator** front end for exceptional selectivity: >100dB at ±12kHz (best available anywhere!) Flutter-proof hysteresis squelch; afc tracks drift. ...kit $149, w&t $219.
- **R451 FM RCVR,** for 420-475 MHz. Similar to above. ...kit $149, w&t $219.
- **R901 FM RCVR,** for 902-928MHz. Triple-conversion, GaAs FET front end. ...$169, w&t $249.
- **R76 ECONOMY FM RCVR** for 28-30, 50-54, 73-76, 143-174, 213-233 MHz, w/o helical res or afc. ...Kits $129, w&t $219.
- **R137 WEATHER SATELLITE RCVR** for 137 MHz. Kit $129, w&t $219.

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QRX . . .

RF Hazards

The FCC is considering new rules which could require radio amateurs and others to show they comply with certain standards of radio frequency radiation safety. Those guidelines have been recommended jointly by the American National Standards Institute (ANSI) and the Institute of Electrical and Electronic Engineers (IEEE).

The Commission's proposal raises complex engineering and public health issues. Compliance could cost in the millions.

For the last decade, the FCC has required commercial broadcasters to prove their operations do not expose their employees or the public to RF radiation in excess of the ANSI standards. Until now, amateurs have been exempt from these regulations. In addition, the guidelines were updated in 1992 and the FCC may decide to adopt these much stricter standards.

At press time, the Commission had extended the comment period on Docket 93-62 three times at the request of various industry groups. *TNX W5YI Report, Issue #3, February 1, 1994.*

Research and Development Growing

The Clinton Administration's proposed 1995 budget includes increases in allocations for a variety of electronics and information technology research and development projects. If the package remains intact, it would increase federal support for R & D to $73 billion, a three-percent hike over 1994.

Officials predict the shift from military to civilian R & D spending will reach parity by 1998—a time frame called too slow by Congressional critics. Research spending was kept afloat at the expense of so-called "big science" projects, however. Cuts included the superconducting supercollider—cancelled by Congress over White House objections—the space station, and a fistful of big-ticket weapons development programs. *TNX Electronic Engineering Times, Issue 784, February 14, 1994.*

Shuttle Ride Was a GaAs

If you have ever built a project utilizing a GaAsFET, varactor, or diode, you already know the value of semiconductor devices made with gallium arsenide. Now the market for gallium arsenide could go sky high after the February flight of the space shuttle *Discovery.*

Astronauts conducted epitaxial thin-film growth experiments in what NASA calls the Wake Shield Facility—a 12-foot-diameter stainless-steel disk used to create an ultra-vacuum in space for epitaxial growth of these GaAs thin films. The vacuum created was designed to be thousands of times more effective than the best laboratory could create on Earth.

A consortium of high-tech companies, universities, and government laboratories is sponsoring the program, which is projected to continue through 1997. If successful, devices grown in space could find applications in digital cellular phones, high-definition television, fiber optic communications, opto-electronics, and perhaps your next home-brew project. *TNX Electronic Engineering Times, Issue 783, February 7, 1994.*

This is Only a Test

One more relic of the Cold War is quickly fading into obscurity. The FCC has announced it is dismantling the 42-year-old Emergency Broadcast System and replacing it with a new computer-based system.

Under the EBS, a daisy chain of phone calls among officials and broadcasters was designed to get the word out to the public. Under the new system, emergency broadcasts will be computerized and automatically sent to radio and TV stations, cable systems, and satellite operators. *TNX The Independent Repeater Association's "The Purple Crystal," No. 36, February, 1994.*

Once And For All

The ARRL has petitioned the FCC to make amateur radio operators' licenses valid for the life of the holder. The League said in its January 6th petition that there is nothing in the Communications Act of 1934 that would prevent a lifetime license term for amateurs, and said the measure would allow inactive amateurs to return to service at the same class of license without retesting. The League says the number of amateurs who could stand to benefit from a lifetime ticket is significant.

Under the current 10-year license structure, the League says it is already possible for relatively inactive hams to remain licensed during periods of extended inactivity. The ARRL says there is no practical difference, then, between such a person and one who allows his or her license to expire and later wants to return to amateur radio. Currently, there is only a two-year grace period under which a lapsed license can be reinstated without the need for re-testing. *TNX Westlink Report, No. 665, January 24, 1994.*

Try, Try Again

By the time you read this, the Earthwinds Hilton around-the-world balloon project may be launched for the fifth time! Hams around the world are looking forward to working the capsule simplex on 145.55 MHz. Launch attempt #4 took place in January. Shortly after a seemingly perfect liftoff from Stead Field Airport in Reno, Nevada, the flight was doomed by a frozen vent valve, and the balloon had to land in an open field just west of Fresno, California.

In a previous attempt a surprise temperature inversion layer prevented the craft from gaining enough altitude to clear the Sierra Mountains. At each attempted flight, ham radio operators on the ground were instrumental in maintaining safety communications for the mission. Two of the three crew members are licensed hams.

Still, after four failed attempts, organizers and crew remain optimistic. If successful, the Earthwinds balloon is expected to circle the earth following the jet stream in 12 to 21 days. *TNX W5YI Report, Issue #3, February 1, 1994; Radio Fun, Issue 28, November, 1993.*

TAPR Has Moved

Tucson Amateur Packet Radio has relocated to new offices. The new mailing address is: **Tucson Amateur Packet Radio**, 8987-309 E. Tanque Verde Rd. #337, Tucson, Arizona 85749-9399. The voice telephone number is (817) 383-0000; FAX (817) 566-2544. *TNX W5YI Report, Issue #3, February 1, 1994.*

For Sale: Big Transmitter

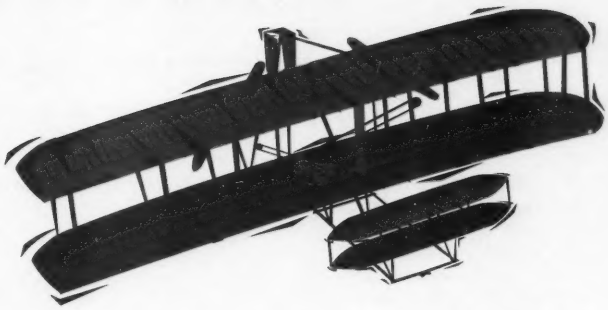
If you've got a few extra million collecting cobwebs in the bank perhaps you'd like to bid on a really big station which is now up for sale in Central America. The Voice of America has announced it will entertain offers for its broadcasting facilities in Belize.

The sale is necessary due to budgetary limitations during the 1994 fiscal year. The Belize relay is located at Orange Point on the Gulf of Honduras, southwest of Punta Gorda. The station is equipped with two 100 kW MW transmitters, two directional antenna arrays, an on-site diesel power plant, satellite terminal equipment, control and monitoring equipment, and associated buildings. The facility is located on 240 acres leased from the Belize government. *TNX Amateur Radio Action, February 1994.*

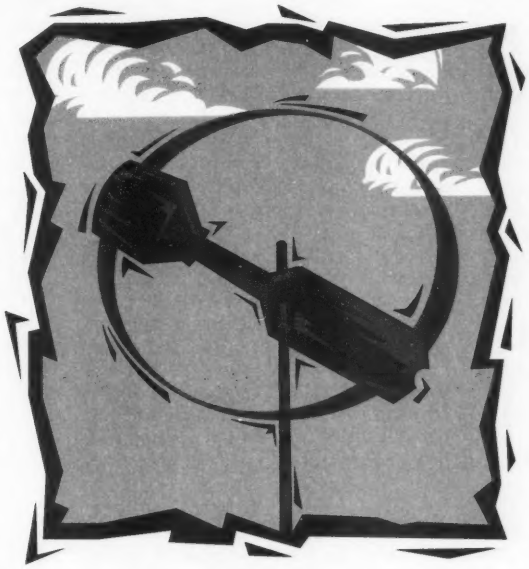
TNX . . .

. . . to all our contributors! You can reach us by phone at (603) 924-0058, or by mail at *73 Magazine*, 70 Route 202 North, Peterborough, NH 03458. Or you can reach us on CompuServe ppn 70310,775@compuserve.com; or at the *73* BBS at (603) 924-9343 (300-2400 bps), 8 data bits, no parity, one-stop bit. News items that don't make it into *73* are often put in our other monthly publication, *Radio Fun.* You can also send news items by FAX at (603) 924-9327.

"THE WORLD IS FLAT"



"THAT THING WILL NEVER FLY"



"THAT ANTENNA IS TOO SMALL TO WORK"

There's one in every crowd—one that pushes the limits and proves the skeptics wrong. The world sailed into a new era of discovery with Columbus. The Wright brothers propelled us into the age of air travel. AEA advances into the ranks of these distinguished pioneers with the IsoLoop 10-30 HF antenna—a 35" loop antenna with low-angle performance that is better than many full-size HF antennas.

One IsoLoop 10-30 HF pioneer offers this: "Big-gun DXers will tell you nothing *that* small can work. They will continue to tell you this after you work a couple hundred countries with it. Ignore them. In 24 months, I have worked 213 countries and confirmed 198."

The reason you get such a big performance in a small package is the efficiency of the IsoLoop 10-30 HF; it's 72% on 20m, rising to 96% on 10m. The main loop serves as an inductor, tuned with a 10,000 volt variable capacitor. Frequency range is 10 MHz to 30 MHz with continuous coverage. The unique compact design is also ideal if you're facing space limitations—mount it in your attic, on a balcony, or go mobile.

With the optional IT-1 Automatic Antenna Tuner (below), tuning your IsoLoop 10-30 HF becomes an adventure in speed— 2 or 3 seconds is typically all the time it takes before you're tuned and ready to go. (Antenna comes standard with a manual tuner.)

Discover the world of big antenna performance in a small antenna. Call our literature request line at (800) 432-8873 and request the "Inside Story" on the IsoLoop 10-30 HF or call us direct at (206) 774-5554. For best pricing, see your favorite amateur radio equipment dealer.

AEA

Connect with us

Motorcycle Mobile!

Take ham radio two-wheeling.

by Irwin W. Fisk KC6QJB

The most frequent complaint of those traveling with VHF/UHF rigs is the indifferent reception they often receive when keying up repeaters in unfamiliar areas. A new legion of hams is finding, however, that this does not apply to them. Instead, they are experiencing the thrill of creating pileups. Motorcycle mobiles represent one of the hottest new trends in ham radio.

Ray Davis KD6FHN is president of MARC (Motorcycle Amateur Radio Club). Davis and two fellow MARC members recently rode their Honda Gold Wings on the Four Corners Ride from San Ysidro, California, to Blaine, Washington; Madawaska, Maine; and Key West, Florida. "It was amazing," says Davis, "There were repeaters, except for wide-open spots in Montana and South Dakota, all the way to Maine and down the East Coast. As soon as I would go on the air with 'This is KD6FHN, motorcycle mobile, looking for local information,' hams would start asking me all kinds of questions . . . we would talk for hours. It was this way from one town to the next."

"The interest in MARC is phenomenal," says Davis. "In less than a year we have picked up over one hundred members." Members donate hundreds of hours each month by riding herd on charity walks, runs, and bicycle rides. A callsign is not a prerequisite for joining MARC, but all of the members are licensed hams. Most were motorcyclists first, and now see ham radio as an enhancement to their enjoyment of riding. Others, like Billy Hall N6EDY, enjoy the fun of trying something new. "I've been licensed since about 1960, and I had tried about everything in ham radio. I heard about this, and I thought great, now I can enjoy both hobbies."

Their rigs run the gamut: handhelds adapted to motorcycles, single-band mobiles, dual- and triband mobiles, 10 meter HF rigs, even a Kenwood TS-50S. Several members have both HF and VHF/UHF capability. Danny Velderrain KD6FLP mounted his 10 meter Ranger RCI-2950 on a crosspiece between his handlebars, and he alternates between his Alinco DJ-102 and Yaesu 50 watt mobile for 2 meter work.

A No-Code Tech often selects a handheld for his first radio—an easy installation for use on a bike. The key component is a speaker/microphone such as Comet's ML-7. The ice-cube-sized unit has two leads that plug into the speaker and microphone jacks of your handheld. Attached to a third lead is a small earpiece that acts as both a speaker and a microphone. Its PTT button allows you to switch between send and receive. The ML-7 is easily attached with a bracket or tape near the left-hand grip, and the antenna can be easily attached via coax to the connector on top of the handheld. Members with handhelds often connect their rubber duck antennas to an adapter, such as the Realistic Suction Cup Accessory, 17-314, made by Radio Shack. This adapter has two side-mounted suction cups near its base. The suction cups stick easily to the windscreen, thus making it ideal for quick setup and takedown.

If prolonged use is anticipated, the rig can be powered by connecting the power leads to the bike's battery. The radio can be nestled into one of the bike's up-front compartments or it can be mounted with Velcro so it can be easily detached for off-bike use. MARC members report working each other on simplex up to 10 miles with their handhelds, 5 watts, and their adapter-mounted rubber duck antennas.

The miniaturization of ham radio is a boon to motorcycle installations. One of the newer innovations is the detachable face feature of some VHF/UHF mobile radios. The small face mounts nicely in front of the rider while the radio tucks safely out of the way in the luggage compartment. If you are installing a dual- or tribander, you can also mount the duplexer or triplexer unit in back with the radio. Antennas can be mounted on the luggage rack, if properly grounded, or in any other convenient rear location. In the case of Gold Wings, several MARC members have replaced their stock issue AM/FM antennas with VHF/UHF models.

The small Kenwood TS-50S is already finding its devotees in motorcycle amateur radio. Ray Davis mounted his TS-50S HF unit in tandem with the face of his Kenwood 741-A VHF/UHF tribander. This gives him a previously unheard of number of HF, VHF, AND UHF radio bands in a foot-square space. Davis connected his Kenwood 741-A to a triplexer that in turn connects to his Comet 224 triband antenna. He connected his TS-50S to a fold-over Comet CA-HV multiband antenna that is mounted on his luggage rack. The CA-HV also works on 2 meters along with the HF bands.

These new detachable-face radios don't preclude one from installing a full-sized mobile rig. Standard mobile radio brackets, secured with sheet metal screws or bolts, can be used for most mobile rigs. You will need

Photo A. MARC members proudly show off their ham-radio-equipped motorcycles.

Photo B. The ML-7 miniature speaker/mike accessory from Comet allows you to easily adapt your HT for motorcycle mobile use.

10 Bands -- 1 MFJ Antenna!

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Operate 10 bands: 75/80, 40, 30, 20, 17, 15, 12, 10, 6 and 2 Meters with one antenna

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***Separate** full size* quarter wave radiators are used on 20, 17, 15, 12, 10 and 2 Meters. On 6 Meters, the 17 Meter radiator becomes a 3/4 wave radiator.

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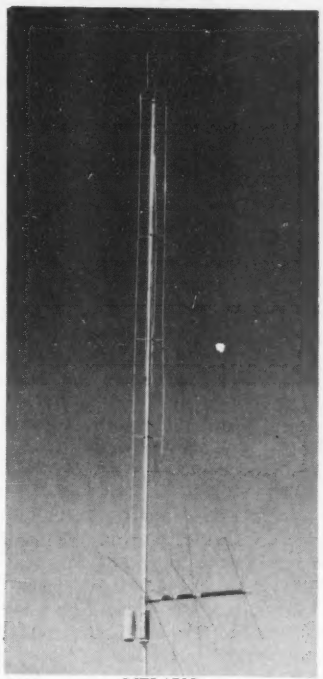

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Super easy-to-use! Only MFJ-1786 *Super* Remote Control has *Auto Band Selection*™. It auto-tunes to your desired band, then beeps to let you know. No control cable is needed.

Fast/slow tune push buttons and built-in two range *Cross-Needle* SWR/Wattmeter lets you quickly tune to your exact frequency.

All *welded* construction, no mechanical joints, welded butterfly capacitor with no rotating contacts, large 1.050 inch diameter *round* radiator -- not a lossy thin flat-strip -- gives you highest possible efficiency.

Each plate in MFJ's *superb* tuning capacitor is welded for low loss and *polished* to prevent high voltage arcing. It's welded to the radiator, has nylon bearing, anti-backlash mechanism, limit switches and a continuous *no-step* DC motor for *smooth precision* tuning.

A heavy duty 1/8 inch thick ABS plastic housing with ultraviolet inhibitors protects it.

MFJ-1782, $269.95. Same as MFJ-1786 but remote control has only fast/slow tune buttons.

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Designed as a *high performance* antenna for 80 and 40 Meters, the MFJ-1792 features a *full size* quarter wave radiator for 40 Meters - - that's a full 33 feet of ruthless radiating power.

End loading -- the most efficient form of loading -- is used for 80 Meters. It's accomplished by a virtually lossless 4½ foot capacitance hat and a high-Q coil wound with Teflon® wire on a *low-loss* fiberglass form.

The *entire length* radiates power.

High strength 6061-T6 aluminum tubing, super strong solid fiberglass insulator, *Frequency Adaptive L-Network*™, heavy duty *swing* mount. Handles 1500 watts PEP. Requires guying and radials, counterpoises or ground screen.

MFJ-1793. $179.95. Same as MFJ-1792 but includes *full size* 20 Meter quarter wave radiator.

Box Fan Portable Loop

MFJ-1780

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No, it's not a fan -- it's a high efficiency portable loop antenna that's about the same size and shape as a 2x2 foot box fan, complete with carrying handle.

Carry it like a suitcase, tuck it in a corner of your car or check it as baggage on a plane.

When you get there, set it on a table or desk and enjoy ragchewing or DXing.

All welded construction, covers 14-30 MHz *continuously* including WARC bands, handles 150 watts. Remote control has fast/slow tune buttons. Separate control cable not needed.

MFJ *halfwave* Vertical

6 bands: 40, 20, 15, 10, 6, 2 Meters . . . No radials or ground needed!

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Photo C. This simple handheld installation can be easily removed to prevent theft.

metal straps to secure the larger radios. You may want to think about the security of your radio before choosing a rig for your bike. The detachable-face radios are less vulnerable to theft, but they are more expensive.

Most rigs are powered by connecting the radio's power leads to the terminals of your battery, but make sure the in-line fuses are in place. This arrangement works fine while the engine is running, but motorcycle batteries are small and not conducive to powering long-winded QSOs while the engine is off. Several MARC members report they operate their mobile rigs on low power to prevent excess battery drain.

VHF/UHF antennas, because of their small size, can be easily mounted nearly anywhere in the rear. Most MARC members install their antennas onto their grounded luggage racks.

HF mobile antennas need to be of a manageable size for motorcycles. Whips can be used for your favorite band, but a multiband such as the Outbacker or Comet's CA-HV will be required for multiband HF work. Most Outbackers will cover from 10 through 75 meters. The CA-HV will cover 2, 6, 10, 15, and 40 meters. A 20 meter loading coil is also available. Make sure the base of the antenna bracket is grounded to the frame of your bike.

The speaker and microphone arrangements are the most problematic aspect of motorcycle radio installation. You have several choices: 1) use the standard mobile radio speaker/microphone arrangement where the microphone hangs on its mounted bracket until you need to reach for it; 2) use the in-your-ear speaker/microphone arrangement discussed earlier in this article; 3) integrate the speaker and/or microphone into your helmet.

The first option has the advantage of being easier to install, but has the disadvantage of outside noise distraction to your speaker. On the plus side, many of the newer rigs have frequency and volume controls built into the microphone.

The second option, the ML-7 or its equivalent, works but reportedly lacks the speaker fidelity of a normal-sized speaker. The ML-7K is needed for use with Kenwood radios. This option works best when handhelds are utilized as mobiles.

Integrating the speaker into the helmet is more complex on the installation end, but makes for a more comfortable mobile operation. One of the simplest methods, used by several MARC members, is to buy Radio Shack's Compact Disc Cassette Adapter #12-1951. It looks like an ordinary cassette tape, except that it has a wire attached to it. They insert the "tape" into their bike's tape deck. The end of the attached wire plugs into the speaker jack of the radio. The audio of the radio feeds through the tape deck into the existing helmet speakers or the bike's external speakers. Member Billy Hall advises setting the ham radio volume on low and controlling the volume with the tape deck's volume control.

Several members of MARC have installed small helmet speakers, such as those made by J&M in the helmet. This speaker, of course, connects directly to the speaker jack of the radio.

Once you have installed your rig on your bike, you are in for an enhanced ham experience. Danny Velderrain sums it up: "When you mention you are a motorcycle mobile, everybody wants a piece of you."

MARC's contact person is Ray Davis, President, 3 Lindberg, Irvine CA 92720; (714) 551-1036. MARC HF nets meet every Tuesday evening: 000 UTC on 14.260; 0100 UTC on 7.250. The VHF net meets Wednesday at 8:00 p.m. PST at 146.985. 73

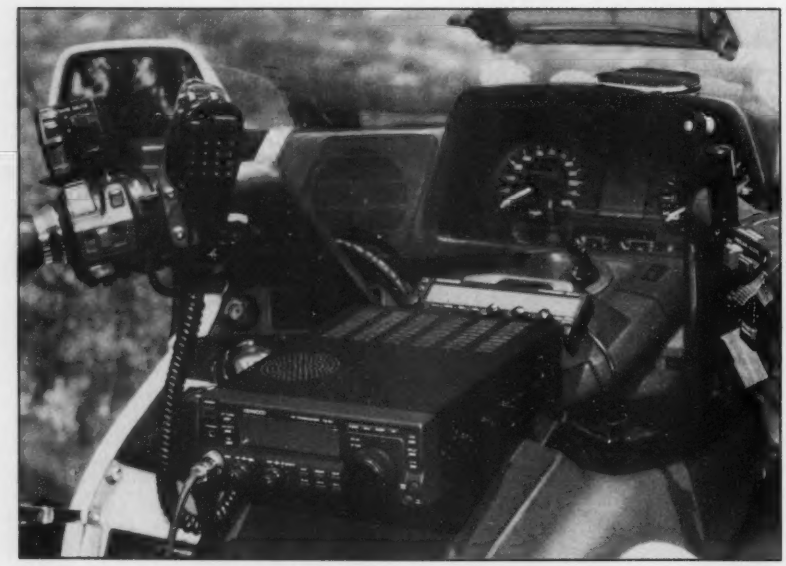

Photo D. What else could you ask for? KD6FHN operates motorcycle mobile with his Kenwood TS-50S (foreground) mounted in tandem with his Kenwood 741-A (faceplate in background).

Photo E. MARC members Ray Davis KD6FHN and Danny Velderrain KD6FLP are deep in a forest of motorcycle mobile antennas.

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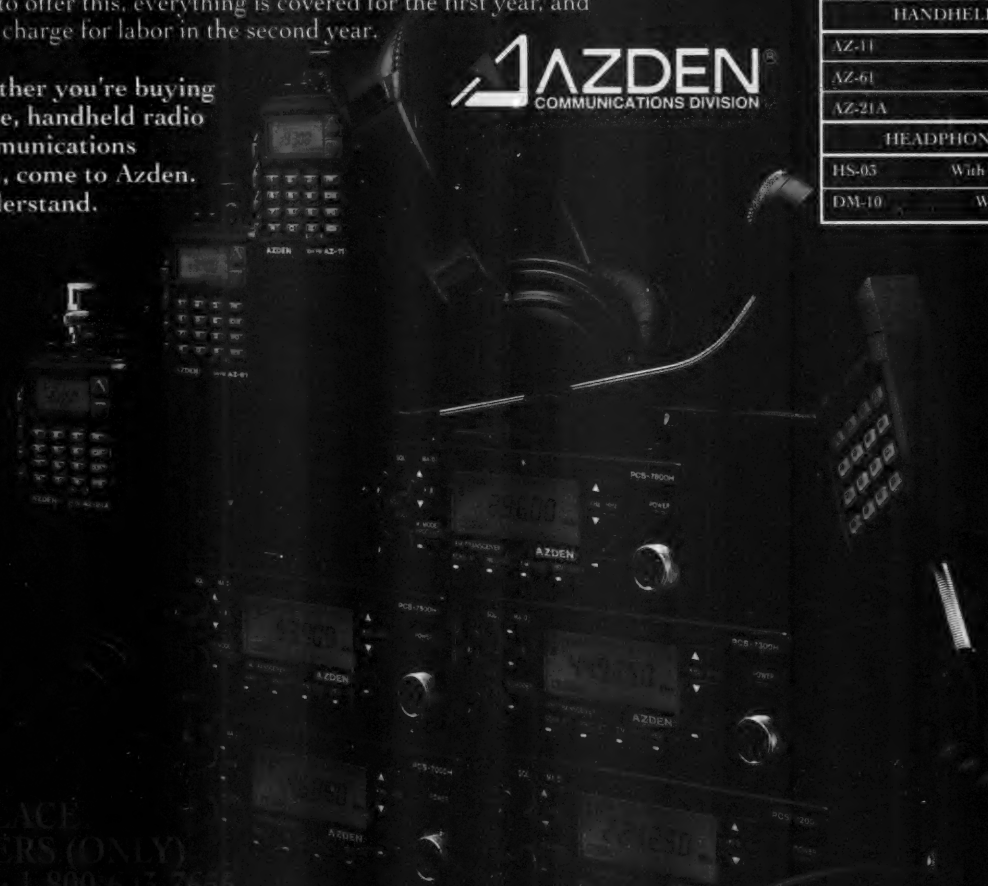

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The 40 Meter Full-Wave Horizontal Loop

Take your signal to the treetops.

by Dean Frazier NH6XK

If you have the space to put up 142 feet of wire in a closed loop configuration, and you desire 10-80 meter operation, including the WARC bands, the 40 meter full-wave horizontal magnetic loop may be just what you're looking for. It doesn't have to be square, out in the open, or very high off the ground to perform well.

My 40 meter loop averages 35 feet in height (about 1/4 wave high on 40 meters), and yields 5-9 signal reports to middle America and 5-6 reports to the East Coast from my QTH on Oahu, Hawaii, with 100 watts. The loop gets 5-9 to 10 dB over into VK and ZL, across open water, and this despite the fact that (1) the loop is buried in and amongst trees of a forest, (2) the loop is not at all square, and (3) my feedline (50 ohm coax terminated with 22' 6-5/8" of 75 ohm coax, velocity factor 0.66, giving 1/4 wave on 7.2 MHz) is almost 300 feet long.

I use #12 AWG copper wire, PVC covered, and I do not use a balun. A 1:1 current balun (inductive coupling) can help to reduce RF signal pickup and re-radiation by the coax braid, but I suggest not using a balun for multiband operation unless the balun is very broadbanded (low Q) lest you burn it up at high reactance levels on frequencies other than the design band. I do cancel RF at the feed point with eight turns of the coax wound to a diameter of 6", taped together as a "coil" or RF air choke.

All antenna attachment points are via 1/8" nylon line terminating in a 3" loop of spaghetti tubing. I avoid direct contact with trees because this seems to increase the antenna's noise level on receive and also seems to cause some degradation of transmitted signal due to energy absorption into the trees (see Figure 1 and Table 2).

On bands other than 40 meters I use a matchbox (L/C circuit) to tune out reactance and help keep the SWR down to allow full power transfer. Some form of magnetic coupling in the transmission train from rig to antenna helps to suppress harmonics which can cause TVI/RFI, so a tuner, no matter how simple, is suggested, regardless of whether it is needed for impedance matching or reactance tune-out.

The feed point mechanical construction consists of a strip of plastic (a 2" PVC strip cut down the middle to make a "plate" or strip, about 9" long) to which is mounted, via plastic ties, an SO 239 connector. One end of the antenna wire is soldered directly into the SO's center conductor; the other, after making its way around the forest through the trees, is attached to the braid side of the PL connector of the coax (now screwed onto the SO connector) by a small hose clamp. (See Figure 2). The plastic strip is hoisted up into the trees by nylon line thrown up previously. I use the "weight and string" method of getting lines up into trees. Some fast

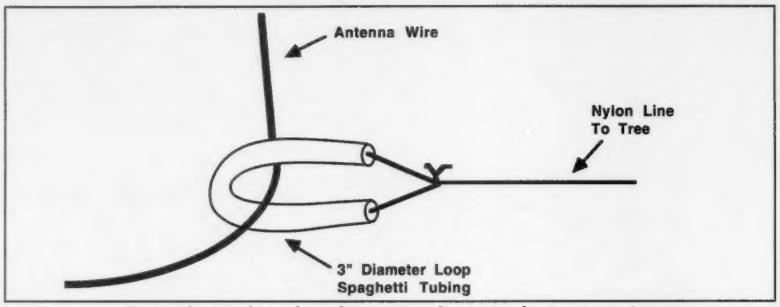

Figure 1. Attaching the nylon support line(s) to the antenna wire.

Band (meters)	Frequency (MHz)	# Waves (on wire)	Gain (dBd)	Feed Point (resistance, ohms)	Wave Angle (degrees)
10	28.500	4	+5+	140	10
12	24.940	3-1/2	+5	130	
15	21.225	3	+4+	125	13
17	18.118	2-1/2	+4	120	
20	14.200	2	+3+	110	15
30	10.120	1-1/2	+3	100	
40	7.150	1	+2+	90	30
80	3.750	1/2	+1+	60	

Table 1. 40 Meter Full-Wave Horiontal Loop (142 feet of #12 PVC covered copper wire) at 35 feet.

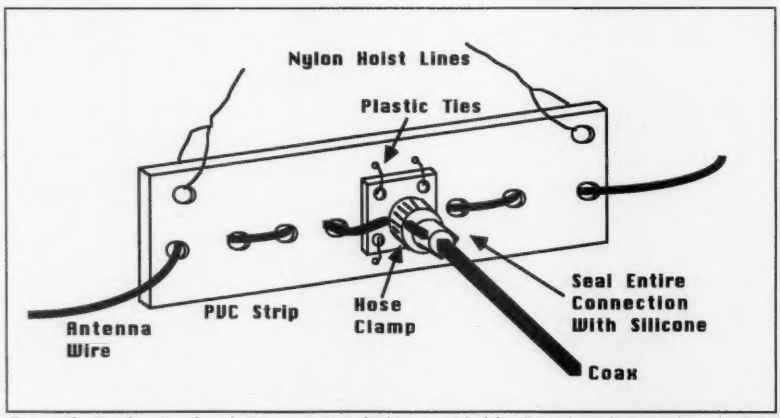

Figure 2. Feed point detail. Wire strain relief is provided by first threading each end of the loop's wires through three holes each about an inch apart, on each side of the S.O. connector, before electrical connections are made.

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```
TNX FER QSO, 73
```

← Incoming data

← Outgoing data appears here

- Store up to nine 256 character messages.

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14.03510-T   0930
3>CANNED     MSG
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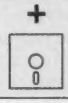
- Messages can be: edited, sent & appended to outgoing message

← Format & Edit stored MSG's here

PC-1610 = [HF XCVR] + [PC] + [DATA CNTLR] + 

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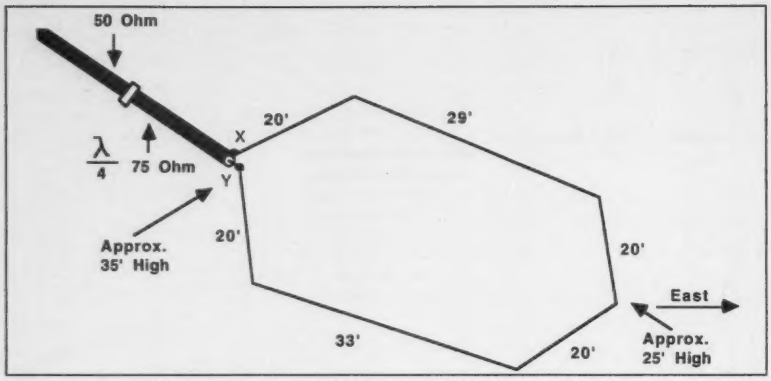

Figure 3. A view of the 40 Meter Full Wave Horizontal Loop.

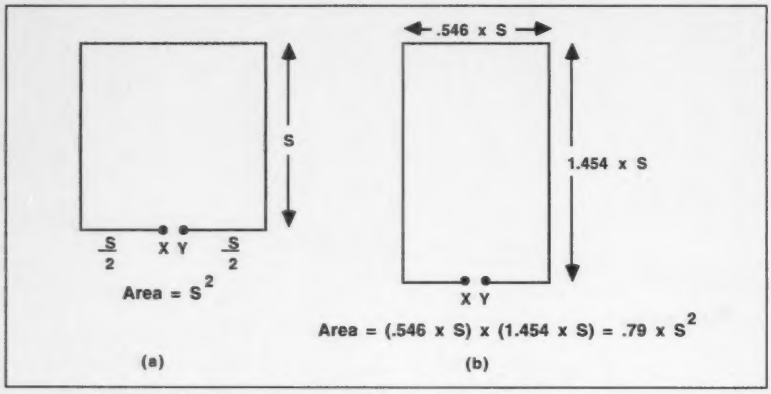

Figure 4. You don't have to make the loop square to make it work well.

twirling and a hard launch at the right angle can put a 4 oz. lead weight with light line some height up. A fishing rod/spinner works well also.

Lots of line throwing, tree branch trimming, climbing, sweat and hard work may be necessary in a thick forest to get the loop up and clear of small branches, but then again, in a clear area some supports for the antenna would be required, and it takes work to put them up, too. So, as long as you can avoid near ($\lambda/2\pi$) field proximity to large (over 6") limbs, the loop will work almost as if the forest weren't there . . . e.g. on 40 meters, try to stay 22 feet away from large tree trunks, 12 feet on 20 meters, etc., otherwise a significant percentage of energy will be absorbed by the trees, resulting in reduced primary signal strength (see Table 1).

Concerning gain and enclosed areas, realize that a square loop (each side 1/4 electrical wave long, all corner angles 90 degrees) has a bit more than 2 dB gain over a dipole at the same height over the same ground. For a not-square loop to lose 1 dB in signal strength compared to a square loop (a just barely detectable audio difference), its enclosed area has to be reduced about 79% of that of a square:

10log (0.79) = -1 dB

The signal from the loop in Figure 4B will be about 1 dB less than that from the loop in Figure 4A.

The point of this geometrical digression has been to show that you don't have to make the loop square to make it work well; just avoid making (if rectangular) the short side less than 0.546 x the length of a square loop's side.

Example:

Total wire in loop = 1005/f(MHz) feet.

40 meter loop wire = 1005/7.077 MHz = 142 feet.

If square, then each side length = 142/4 = 35-1/2 feet, but not less than 0.546 x 35-1/2 = 19-1/3 feet.

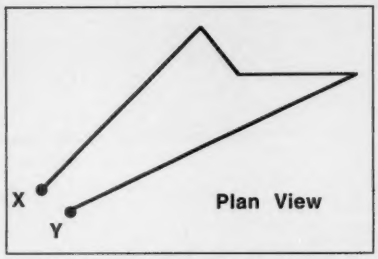

Figure 5. Internal angles of less than 90 degrees can cause signal cancellation problems.

Avoid internal angles less than 90 degrees. Don't use a design like that in Figure 5, for obvious reasons of signal cancellation.

If you desire stronger propagation in a preferred direction, angle the plane of the loop toward the desired direction in a sloping loop (or diamond) configuration (see Figure 6).

But if you do make the loop into a diamond shape and slope it, don't let the short width (across) become less than 0.885 x the length of a side when square (see Figure 7).

Specifically, for 40 meters, a sloping diamond would look like Figure 8 (The sketch shows the minimum width and maximum length allowable before the loss resulting, compared to that of a square loop, exceeds 1 dB).

Comment: My 80 meter SkyLoop (282 feet of wire, another antenna) enjoys the advantage of both horizontal and vertical polarization, as half of the loop (the west half) is more or less horizontal, while the remaining east half slopes down into a gulch. The result is that the SkyLoop is effectively a sloping loop. It's plan layout is not at all square, but the short width is greater than 0.885 x the length of a square loop's side.

Always feed horizontal loops at their highest point. And note that a 40 meter full-wave loop is a half-wave vertical on 80 meters, the loop functioning as a capacitance

Continued on page 18

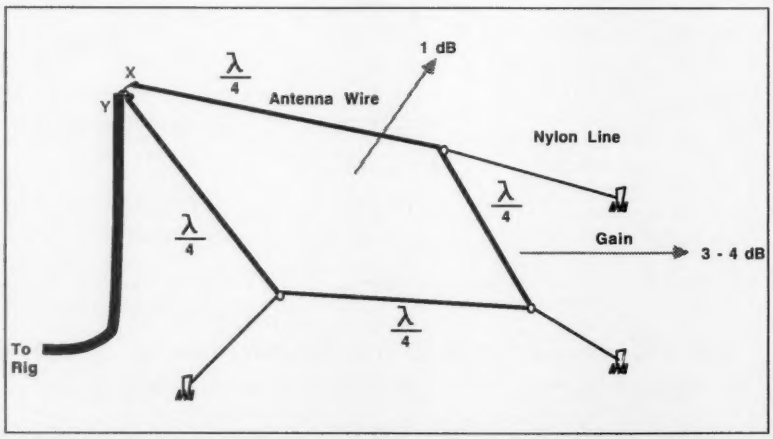

Figure 6. Directional enhancements are made by positioning the plane toward the desired angle.

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The 40 Meter Full-Wave Horizontal Loop

Continued from page 16

hat for radiation from the vertical feedline.

Horizontal loops are easy to build, erect, and require no tuning if you cut the wire according to L = 1005/f (MHz) feet, where the frequency f is for the lowest band of desired operation. Feed the loop either directly with 50 ohm coax or with a quarter wave (electrical, considering velocity factor) of 75 ohm coax; again, the quarter-wave matching section's length is based on the lowest frequency of planned operation. Of course, tuned feeders may also be used.

For those who are unable to erect antennas very high, the 142-foot length of wire as a 40 meter full-wave horizontal loop about 35 feet above ground is a winner. And it doesn't have to be textbook square, or horizontal, to be effective.

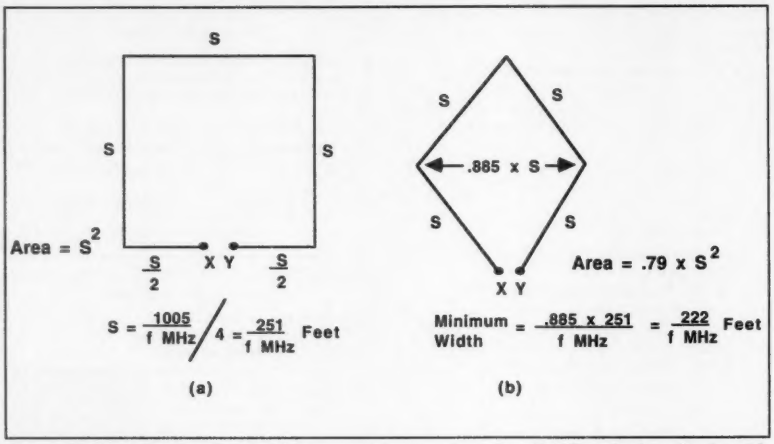

Figure 7. Don't let the short width (across) become less than 0.885 x the length of a side when square.

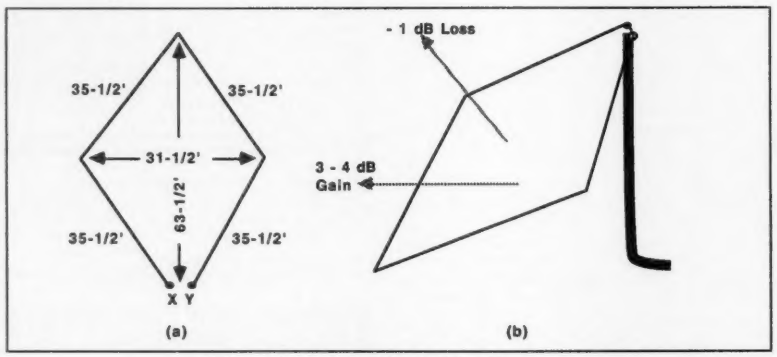

Figure 8. A sloping diamond for 40 meters.

Band (meters)	Near-Field (λ/2π) Clearance Distance (feet)
10	6
12	7
15	8
17	9
20	12
30	16
40	22
80	42
160	83

Table 2. When an antenna is within λ/2π feet of a nearby object, such as a tree (a capacitor) or some metal (an inductor), being the free space wavelength at the frequency of operation (feet), primary signal attenuation occurs due to the energy of the near (storage) field being absorbed by the tree or metal. As a result, this energy is no longer available to reinforce, by ground reflection, the signal of the primary radiation. The loss can amount to as much as 6 dB. To avoid this phenomenon, keep all antenna wire at least these distances away from 6" diameter or larger energy-absorbing objects:

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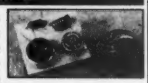
MICRO-MIKE



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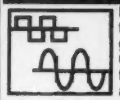

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The Big Kahuna

A 15' high, 160 meter Distributed Capacity Twisted Loop Antenna.

by Jim McLelland WA6QBU

If you're like most hams, you don't come close to having enough room for an antenna for our lowest band, 160 meters. Not being much different, I not only lack sufficient space for a low-band antenna but, like most cliff dwellers before me, I can't even put up an outside clothesline. So, I developed the Distributed Capacity Twisted Loop (DCTL) prototype on 40 meters (see *73*, September 1993, page 26) and then applied what I learned to a 160 meter version.

The result is a 15-foot-high equilateral triangle that you can hang on the side of your house or, like I do, from the balcony when the XYL isn't looking. It can be built in a couple of hours, doesn't cost much and, as the title (Big Kahuna) suggests, packs a real punch. If you've got room for a 10 meter dipole you've got room for this, so quit stalling, get out your soldering iron and go for it.

Description

The DCTL is a loop made from 300 ohm twinlead, but with a twist. To understand the "twist," look carefully at Figure 1. You'll notice that opposite ends of the loop do not connect to each other. This is a critical point in getting the loop to resonate. These open, opposite ends connect to a capacitive stub that does the fine tuning, but most of the tuning capacitance is distributed along the whole length of the loop. It is this capacitance that lowers the frequency of the wire loop so that about 1/8 wave will resonate instead of the usual 1/2 wavelength. In short, a loop about 50 feet long (15 feet across) has replaced a 246-foot-long dipole. The impedance drops drastically and must be raised back to 300 ohms. This is accomplished with a shorted "hairpin" stub impedance matching device across the feedline. The net result is a loop antenna resonated between 1.8—2.0 MHz with a 300 ohm impedance and a "Q" of 100. This produces a very narrow bandwidth of about 20 kHz. However, you can easily adjust the SWR to 1:1 over the entire 200 kHz, 160 meter band with a balun and tuner.

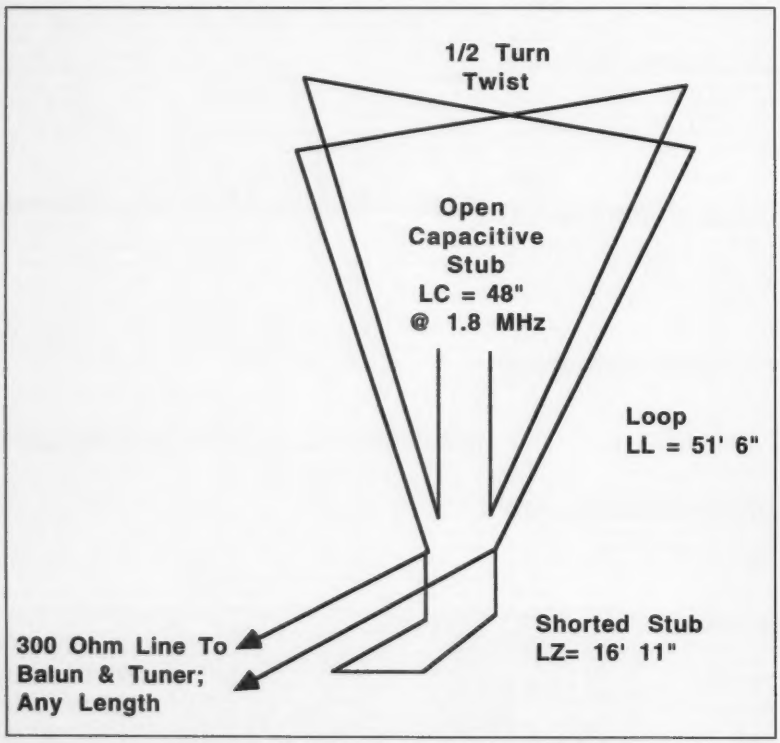

Figure 1. The Big Kahuna 160 meter DCTL dimensions.

Construction

The loop is cut for 2.0 MHz and the capacitive stub is made long enough to pull the resonant frequency down to 1.8 MHz. Then it is easy to trim the stub to anywhere in the band. All DCTL parts are made from 3/16" twinlead, available from Radio Shack (15-1153), or you can order a complete kit from Antennas West (see the Parts List). Either way, you'll have enough wire left over for some lead-in to the balun/tuner.

Figure 1 shows the lengths required. Remember, they are critical, so *measure carefully*. Twist together and solder all connections. Don't forget to put pieces of shrink tubing on all the leads *before* you solder anything! After soldering and insulating, the shorted "hairpin" stub (16'11") can be attached directly to the lead-in with shrink sleeving, or it can be rolled up into a 12"-diameter loose coil, or it can even be left to hang free. The antenna characteristics change a little from one method to the other, but they all work fine.

The open stub is quite frequency-sensitive. Keep it away from other antenna components and metal in general. If it can't hang freely, attach it to an insulator, such as a twinlead standoff.

The 48" length lowers the loop resonant frequency 200 kHz and its effect seems to be fairly linear. Before you do any trimming, however, complete the construction and install the antenna. You should do it this way because the shape also affects the frequency somewhat, with the resonant frequency going up as the feed point angle gets larger. The loop itself (51.5') *must* be connected so that there is *no continuity* (infinite resistance) between the terminals that connect to the feedline. Check and connect these leads before the shorted "hairpin" stub is attached.

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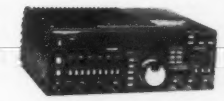

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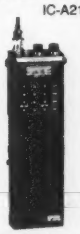

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CIRCLE 41 ON READER SERVICE CARD

Installation

If your operating location permits, mount the DCTL as an equilateral triangle or diamond, with the feed point down. If not, then go for the most area inside the loop that you can, given your situation. The DCTL will also work as a wide-spaced two-turn loop, but it's down about one "S" unit in comparison. You'll need to retune somewhat, but that's not difficult.

Be sure to use insulating material to support the loop. Nonconducting clothesline works well if beauty isn't important (I keep my odd-shaped creation in the attic). Those of you concerned with aesthetics can get by on an outside wall by following trim boards, using traditional standoffs, and painting your loop the same color as the house. Don't forget, though, that you must stay away from metal objects such as flashing, vents, and downspouts. This includes the lead-in itself. Also, if you have the choice, put the plane of the loop in your favorite directions as it definitely has deep broadside null points.

Tuning

The minimum equipment necessary to get this system working is an SWR bridge, a balun, and a tuner. Without the tuner, your bandwidth is only abut 20 kHz, but with it, you can QSY the whole band with no trouble. There are several "no tuner" options to QSY but they all require changing the effective length of the capacitive stub. You could make several stubs for different frequencies and attach them with banana plugs, or use a rotary switch, or even rig up a remote relay system. I've tried all of these and finally decided that while it was fun to experiment, the tuner worked just as well.

To resonate the loop, trim short pieces off of the capacitive stub until the SWR is where you want it. Remember that shortening the stub 24" moves resonance up about 100 kHz. The best way to check this all out is to use an antenna bridge. Then you can find the starting point and trim until you're in the middle of the band, or where you prefer to be. You may be somewhat below the band edge if your feed point angle is less than 60 degrees (equilateral triangle); with only an SWR bridge, it may be difficult to find the proper stub length. Trimming 3" at a time and checking for an SWR dip is the best procedure, remembering that each change will move the antenna up about 10 kHz. If you don't feel like doing this, cut the stub to 24", resonating the antenna somewhere in the band (hopefully the middle), and use your balun/tuner for the rest. I later discovered that the tuner would resonate the loop on every band down to 10 meters and my antenna bridge showed sharp resonant points on 7, 14, 21, and 28 MHz as well as on the design band.

Testing

Believe me when I say this thing works! I contacted stations out to about 700 miles with S9 signals both ways and my noise level was always below S3. Band conditions were bad and I could still hear northern stations over 1,000 miles away. I didn't try to work them as they were all in round tables and I hated to break-in since I couldn't hear everyone. I later figured out that they were broadside to the loop and in the general area of the null. A 90 degree turn made the north-south stations much stronger.

By the way, the locals tell me that there's even DX late at night! I can't wait.

Another thing to remember, and one reason why I developed this antenna, is that the sunspot cycle is still on the wane. There may be nights when 160 is the only band left working. I'll be ready! Will you? 73

Parts List

All parts needed to build this (160 meter) antenna, or the 40 meter model described in the September 1993 issue of *73*, are available in the "Compact Loop Experimenter's Kit." The parts are:

Twinlead - 5/16"	100'
Shrink tubing - 3/8"	1'
Shrink tubing - 3/16"	1'
Banana plugs	2
Dacron line	50'
Double split twinlead	
Insulators w/hardware	4

Introductory price w/shipping (40% discount for *73* readers): $24

Available from:

Antennas West
1500 N 150 W
Provo UT 84604
Tel. (801) 373-8425

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- HEAVY DUTY HEAT SINK • CHASSIS MOUNT FUSE
- THREE CONDUCTOR POWER CORD except for RS-3A
- ONE YEAR WARRANTY • MADE IN U.S.A.

PERFORMANCE SPECIFICATIONS

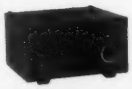
- INPUT VOLTAGE: 105-125 VAC
- OUTPUT VOLTAGE: 13.8 VDC ± 0.05 volts (Internally Adjustable: 11-15 VDC)
- RIPPLE Less than 5mv peak to peak (full load & low line)
- All units available in 220 VAC input voltage (except for SL-11A)

SL SERIES

• LOW PROFILE POWER SUPPLY

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
SL-11A	•	•	7	11	2⅝ × 7⅛ × 9¾	12
SL-11R	•	•	7	11	2⅝ × 7 × 9¾	12
SL-11S	•	•	7	11	2⅝ × 7⅛ × 9¾	12
SL-11R-RA		•	7	11	4¾ × 7 × 9¾	13

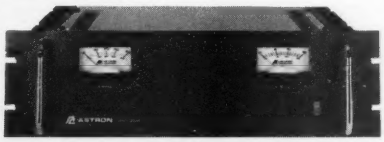
RS-L SERIES



• POWER SUPPLIES WITH BUILT IN CIGARETTE LIGHTER RECEPTACLE

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-4L	3	4	3½ × 6⅛ × 7¼	6
RS-5L	4	5	3½ × 6⅛ × 7¼	7

RM SERIES



MODEL RM-35M

• 19" RACK MOUNT POWER SUPPLIES

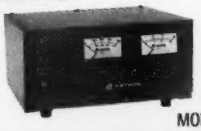
MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RM-12A	9	12	5¼ × 19 × 8¼	16
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
RM-60A	50	55	7 × 19 × 12½	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

RS-A SERIES

MODEL RS-7A

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-7B	•	•	5	7	4 × 7½ × 10¾	10
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46
RS-70A	•		57	70	6 × 13¾ × 12⅛	48

RS-M SERIES



MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46
RS-70M	57	70	6 × 13¾ × 12⅛	48

VS-M AND VRM-M SERIES

MODEL VS-35M

• Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

MODEL RS-12S

• Built in speaker

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18
SL-11S	•	•	7	11	2¾ x 7⅝ x 9¾	12

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

by Jeff M. Gold AC4HF

The Lightning Bolt Quad

An HF five-band, two-element, cubical quad antenna.

Lightning Bolt Antennas
RD #2 RT 19
Volant PA 15156
Telephone:(412) 530-7396
Price Class: $289 complete

Most hams are familiar with that age-old wisdom: "Put your money into your station's antenna." It is nice to have a full-featured HF transceiver, but the antenna is much more critical. With a directional antenna you can effectively increase your signal strength and help eliminate signals coming into the back and sides of your antenna.

Quad or Not

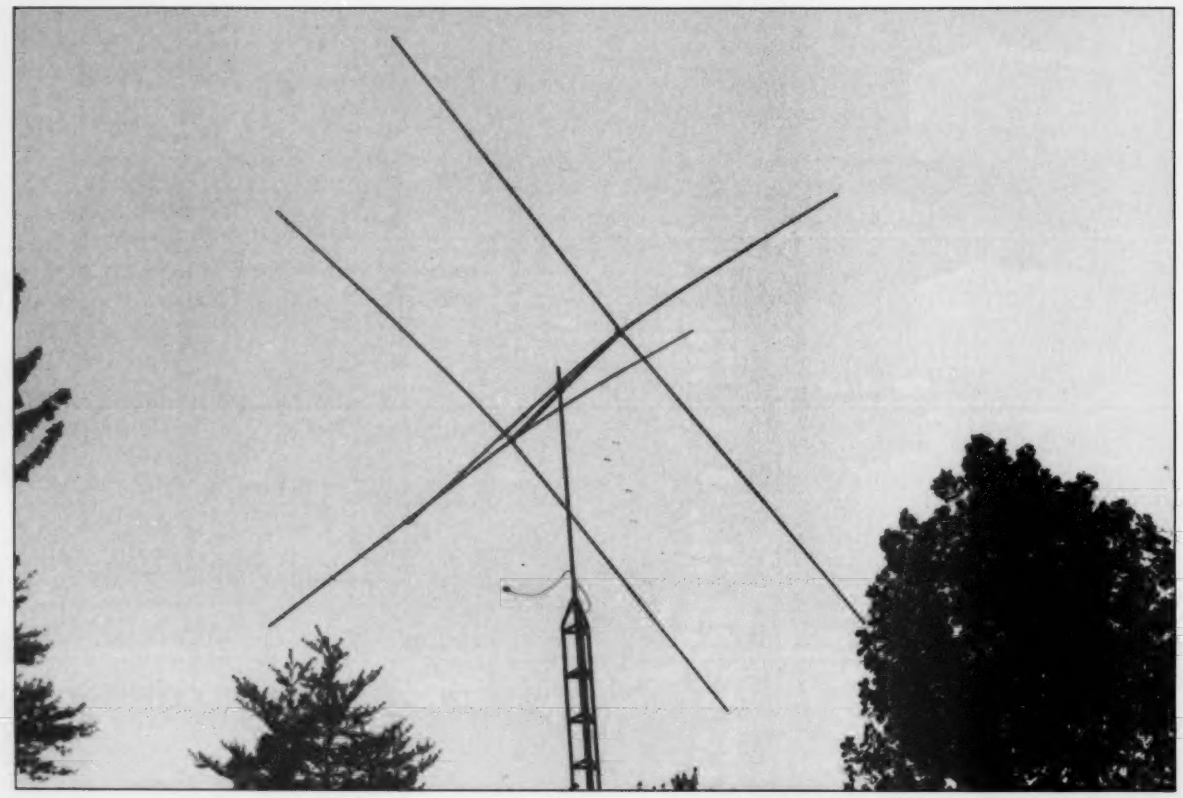
The two most popular types of directional antennas are quads and yagis. Up until recently yagis have been more popular. Quads had a reputation of not being as rugged as yagis, due to the construction materials available in the past.

A two-element quad has the same amount of gain and front-to-back ratio as a three-element yagi, and can be as effective at a lower height. Since the quad is a lower "Q" antenna than a yagi, the spacing between its elements is not as critical. The quad is also quieter with atmospheric noise than the yagi.

Lightning Bolt Antennas sells a two-element five-bander (covering 10, 12, 15, 17, and 20 meters). The antenna is designed to stand up to tough weather conditions. Lightning Bolt uses a special Fiberglas wrapping technique for the spreaders. The supports are made of heavy-duty welded aluminum and all the materials are top quality.

Building the Antenna

The instruction manual is five pages long. Most of those pages are taken up by diagrams. The first steps guide you through assembling the spreaders. There are 16 hollow Fiberglas sections. You take them in sets of two and adjust them to the specified length and secure them with hose clamps. The actual length is not critical; you just need to be in



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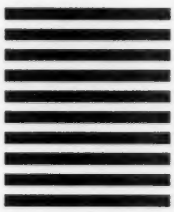

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Save $25.00

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Radio Scanners

Bearcat® 2500XLT-H

List price $649.95/CE price $339.95/SPECIAL
400 Channels · 20 Banks · Turbo Scan
Rotary tuner feature · Auto Store · Auto Sort
Size: 2-3/4" Wide x 1-1/2" Deep x 7-1/2" High
Frequency Coverage: 25.0000 - 549.9950, 760.0000 - 823.9950, 849.0125 - 868.9950, 894.0125 - 1,300.0000 MHz.

Signal intelligence experts, public safety agencies and people with inquiring minds that want to know, have asked us for a world class ***handheld*** scanner that can intercept just about any radio transmission. The new Bearcat 2500XLT has what you want. You can program frequencies such as police, fire, emergency, race cars, marine, military aircraft, weather, and other broadcasts into 20 banks of 20 channels each. The new rotary tuner feature enables rapid and easy selection of channels and frequencies. With the AUTO STORE feature, you can automatically program any channel. You can also scan all 400 channels at 100 channels-per-second speed because the Bearcat 2500XLT has TURBO SCAN built-in. To make this scanner even better, the BC2500XLT has AUTO SORT - an automatic frequency sorting feature for faster scanning within each bank. Order your scanner from CEI.

For more information on Bearcat radio scanners or to join the Bearcat Radio Club, call Mr. Scanner at 1-800-423-1331. To order any Bearcat radio product from Communications Electronics Inc. call 1-800-USA-SCAN.

Great Deals on Bearcat Scanners

Bearcat 8500XLT-H base/mobile	$369.95
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Bearcat 2500XLT-H handheld	$339.95
Sportcat 150-H handheld	$199.95
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Bearcat 560XLA-H base/mobile	$84.95
Bearcat 220XLT-H handheld	$229.95
Bearcat 200XLT-H handheld	$199.95
Bearcat 148XLT-H base	$88.95
Bearcat 120XLT-H handheld	$159.95
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NEW! RELM® WHS150-H1

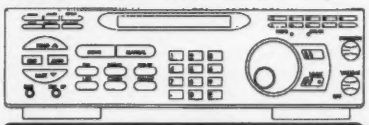
List price $481.67/CE price $339.95/SPECIAL
16 Channel · 5 Watt VHF scanning transceiver
Size: 2.45" Wide x 1.38" Deep x 6.4" High
Frequency range:148.000 to 174.000 MHz. continuous coverage. Will also work 144.000-148.000 MHz. with reduced performance.

The RELM WHS150 is our most popular programmable five watt, 16 channel handheld transceiver. Weighing only 15.5 oz., it features dealer programmable synthesized frequencies either simplex or half duplex in both 5.0 and 6.25 KHz. increments. Other features include scan list, priority channel, selectable scan delay, selectable 5 watt/1 watt power levels, liquid crystal display, time-out timer and much more. When you order the WHS150 from Communications Electronics Inc., you'll get a complete package deal including antenna, battery, belt clip and user operating instructions. The radio technician maintaining your radio system must order programming instructions part #PI150 for $18.00 to activate this radio.

Bearcat® 8500XLT-H

List price $689.95/CE price $369.95/SPECIAL
500 Channels · 20 banks · Alphanumeric display
Turbo Scan · VFO Control · Priority channels
Auto Store · Auto Recording · Reception counter
Frequency step resolution 5, 12.5, 25 & 50 KHz.
Size: 10-1/2" Wide x 7-1/2" Deep x 3-3/8" High
Frequency Coverage:
25.000 - 28.995 MHz. (AM), 29.000 - 54.000 MHz. (NFM), 54.000 - 71.995 MHz. (WFM), 72.000 - 75.995 MHz. (NFM), 76.000 - 107.995 MHz. (WFM), 108.000 - 136.995 MHz. (AM) 137.000 - 173.995 MHz. (NFM), 174.000 - 215.995 MHz. (WFM), 216.000 - 224.995 MHz. (NFM), 225.000 - 399.995 MHz. (AM) 400.000 - 511.995 MHz. (NFM), 512.000 - 549.995 MHz. (WFM) 760.000 - 823.9875 MHz (NFM), 849.0125 - 868.9875 MHz (NFM) 894.0125 - 1,300.000 MHz. (NFM).

The new Bearcat 8500XLT gives you pure scanning satisfaction with amazing features like Turbo Scan. This lightning-fast technology featuring a triple conversion RF system, enables Uniden's best scanner to scan and search up to 100 channels per second. Because the frequency coverage is so large, a very fast scanning system is essential to keep up with the action. Other features include ***VFO Control*** - (Variable Frequency Oscillator) which allows you to adjust the large rotary tuner to select the desired frequency or channel. ***Counter Display*** - Lets you count and record each channel while scanning. ***Auto Store*** - Automatically stores all active frequencies within the specified bank(s). ***Auto Recording*** - This feature lets you record channel activity from the scanner onto a tape recorder. You can even get an optional ***CTCSS Tone Board*** (Continuous Tone Control Squelch System) which allows the squelch to be broken during scanning only when a correct CTCSS tone is received. ***20 banks*** - Each bank contains 25 channels, useful for storing similar frequencies in order to maintain faster scanning cycles. For maximum scanning enjoyment, order the following optional accessories: **PS001** Cigarette lighter power cord for temporary operation from your vehicle's cigarette lighter $14.95; **PS002** DC power cord - enables permanent operation from your vehicle's fuse box $14.95; **MB001** Mobile mounting bracket $14.95; **BC005** CTCSS Tone Board $54.95; **EX711** External speaker with mounting bracket & 10 feet of cable with plug attached $19.95. The BC8500XLT comes with AC adapter, telescopic antenna, owner's manual and one year limited warranty from Uniden. Order your BC8500XLT from Communications Electronics Inc. today.



CB/GMRS Radios

The Uniden GMR100 is a handheld GMRS UHF 2-way radio transceiver that has these eight frequencies installed: 462.550, 462.725, 462.5875, 462.6125, 462.6375, 462.675, 462.6625 and 462.6875 MHz. This one watt radio comes with flexible rubber antenna, rechargeable ni-cad battery, AC adapter/charger, belt clip, F.C.C. license application and more.

Cobra 2000GTL-H SSB DeluxeCB Base	$419.95
Uniden GMR100-H GMRS Handheld	$169.95
Uniden WASHINGTON-H SSB CB Base	$189.95
Uniden GRANTXL-H SSB CB Mobile	$149.95
Uniden PC76XL-H CB Mobile	$99.95
Uniden PC122XL-H SSB CB Mobile	$107.95
Uniden PRO510XL-H CB Mobile	$36.95
Uniden PRO520XL-H CB Mobile	$49.95
Uniden PRO538W-H CB & Weather	$69.95

Shortwave

ICOM R1-H ultra compact handheld wideband receiver	$469.95
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ICOM R7100-H base with 900 memory (add $49.00 shipping)	$1,289.95
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Sangean ATS606-H ultra compact 45 memory shortwave	$149.95
Sangean ATS606P-H shortwave with antenna & AC adapter	$169.95
Sangean ATS800-H1 portable 20 memory shortwave	$69.95
Sangean ATS803A-H portable with SSB reception & AC adapter	$159.95
Sangean ATS808-H portable 45 memory shortwave	$159.95
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Specifications

Gain	8 dB
Front-to-back	26 dB
Side lobe	50 dB
Boom diameter	2"
Turning radius	10.6'
Weight	35 lbs.
Arm length	12'9"

SWR Measurements

Actual SWR measure after installation using given assembly measurements:

10 meters	28.000	2.0:1
	28.200	1.7:1
	28.300	1.5:1
	28.500	1.12:1
	28.700	1:1
	29.000	1.2:1
	29.700	1.6:1
12 meters		1.5:1 or better
15 meters		Better than 1.4:1
17 meters		1.5: or better
20 meters	14.000	1:1
	14.100	Better than 1.2:1
	14.350	1.2:1

the ballpark. You next attach the spreaders to the metal spider using some more hose clamps.

The first element to work on is the reflector. You take wire holders and attach them along the length of each spreader at given distances from the center of the spider. You need to be close on your measurements, but not exact. You will end up moving these later to adjust the wires.

The next step is critical. You need to measure and cut the wires as specified. The wire is lightweight aluminum alloy and it comes on two small spools. Be very careful when measuring and cutting—the wire likes to stay spooled up. If you let it slip, it will coil back with a good deal of force and this could cause an injury.

I cut and installed each wire separately. Once the wire is cut, you run it through the wire holders. The wires are fastened to a clear Plexiglas insulator. You adjust the wires by sliding the wire holders back and forth and you will want to adjust them so that there is a slight bow in the Fiberglas spreaders. The wires on mine seemed a little loose in this configuration, but I do have the slight bow in each element's spreaders.

There was only one unclear part in all the instructions. This involved the tuning stubs for the reflector element. There is a section that describes an eight-inch adjustable stub (step 4B) and then the next section gives exact measurements for the stubs for each of the five bands. The first part of this step is meant for those who will want to play with the front-to-back ratio versus gain. I chose to use the specified measurements and didn't figure I wanted to mess with this antenna, if in fact I ever got it all assembled. Using the preset reflector stub measurements is meant to give a good compromise between front-to-back ratio and gain.

I took my time building it. I assembled the spider parts one night, then built the reflector, then the driven element. All the parts were included and of top quality materials. The antenna is very lightweight when assembled.

The SWR and bandwidths are shown in the chart. All measurements exceeded the manufacturer's claims.

On the Air

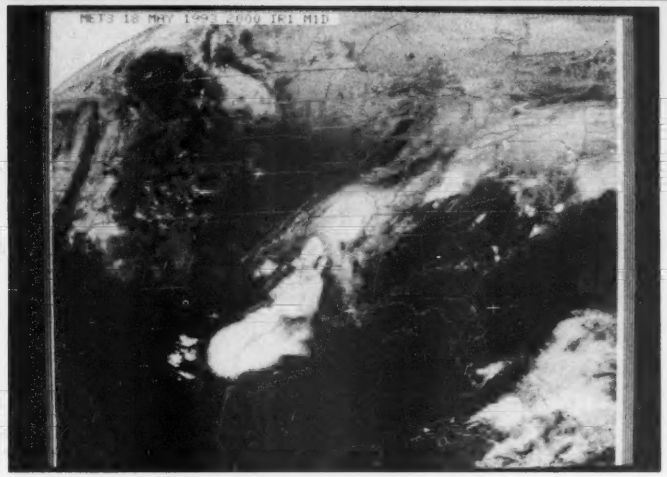
I turned on the radio and worked VP5M in the Caicos Islands on 15 meters, then I8UDM and CT1GG/CU3, both on first calls through pile-ups. *[Editor's note: The author's QTH is in Tennessee.]* Next, I hooked up an antenna switch and went back and forth between my trusty vertical and the quad. The vertical would read 5-1 and the quad would read 5-7 to 5-9. In some cases I couldn't even hear the station on the vertical but it would be nice and strong on the quad.

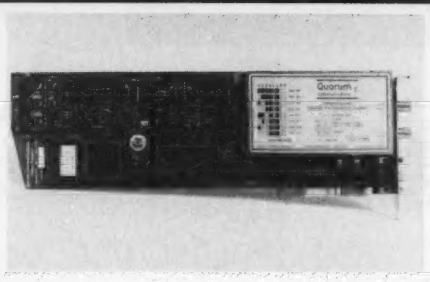
WS4S, the only other QRPer in town, came over the same evening to help work on a friend's tube rig. He had to play with the new antenna before we started on the rig. The first thing he did was turn the power on the rig down to 1 watt and work 4X1EL, after which I worked him also. He turned the power down to 20 mW and worked Z36CXN in Macedonia. I really wanted the same station, so I cheated and cranked the power all the way up to 70 mW.

Next he turned the power to 50 mW and called CQ once. He said "this is futile." He called one more time and YO8CDC came back to him. He talked to this guy on 20 meters and turned the power down to 10 mW. The RST was 5-4-9.

Next he worked HA5HC in Hungary. He started with 50 mW and the RST was 5-7-9. He started chatting and turned the power down to 10 mW. The RST was now still 5-7-9 and Emil reported the signal was nice and strong. Next he turned the power to 1 mW and the RST was still a 5-5-9. Conrad WS4S talked with Emil HA5HC for quite some time on *very low power.* 73

Explore The World of Quorum Wefax





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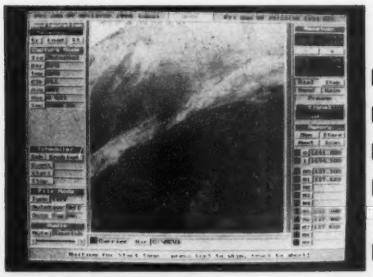

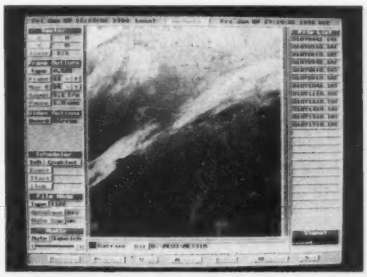

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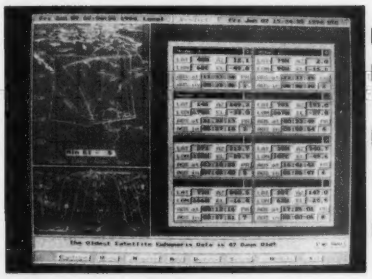

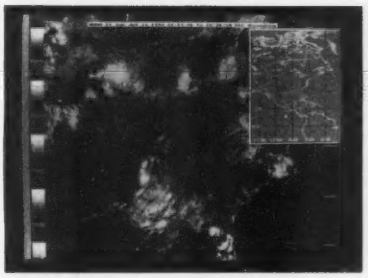

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CIRCLE 257 ON READER SERVICE CARD

73 Review

Number 8 on your Feedback card

by Steve Katz WB2WIK/6

Diamond Antenna Corporation
Distributed by RF Parts
435 So. Pacific St.
San Marcos CA 92069
Telephone: (619) 744-0900
Price Class: $174.95 suggested retail

The Diamond X2200A

A high-gain UHF/VHF omnidirectional base station antenna.

The Diamond Antenna Corporation of Tokyo has emerged as a premier amateur antenna manufacturer offering strong competition to the well-established American companies. They are already well-known for their "F," "U," and "X" model base-station VHF-UHF gain antennas. These models feature commercial performance at amateur prices and are easily recognizable by their gleaming white Fiberglas radiator casings and dual-band mobile whip antennas. Even their mobile whip antenna mounts are famous and rather innovative in design. I've been using a Diamond model F-23A for more than two years now as a repeater antenna on my 145 MHz repeater system. It's been working like a charm, creating excellent coverage with its low-angle radiation pattern and causing absolutely no receiver desensitization in full-duplex service at the 50 watt power level.

The X-2200A is a rather new product introduced for the American market just last year. It offers claimed omnidirectional gain of 6.0 dB on 146-148 MHz and 7.8 dB on 222-225 MHz, and because it covers the 1.25 cm band it has no domestic market in Japan (where 222 MHz is not an authorized amateur band).

This antenna employs a 3/4-wavelength center-loaded radiator on 2 meters and three 5/8-wavelength phased radiators on 1-1/4 meters, with the radiating elements made of brass and all the "works" enclosed in a beautiful Fiberglas "radome" (antenna cover). At the base (feed point) of the antenna, it has three quarter-wavelength drooping (downsloped) radials to decouple it from its support and coaxial feedline. And, the X-2200A weighs in at a scant 2.64 lbs. The antenna is 11-1/2 feet tall fully assembled and is UPS-shippable because it comes broken down into two radiator sections plus the radial kit, base support tube and mounting hardware. Assembly requires only a Phillips screwdriver and takes about five minutes.

While the X-2200A is rated for "150 watts" maximum transmitter power, this is a very conservative rating. In fact, I have no clue why Diamond places such a low-power rating on the antenna, since its only active components are the brass rods which make up the radiator and some air-dielectric phasing/loading inductors which appear rugged enough to handle considerably more than the rated power. When I was testing the 2 meter omni model F-23A at home prior to installing it on a repeater, I transmitted with 1,000 watts of output power into this "200 watt" rated antenna for several minutes with no ill effects. Possibly the manufacturer is rating the X2200A based on the assumed use of a "duplexer" (RF signal-splitter) which most hams would use to separate the RF energy for the two service frequencies when using a single feedline to operate two bands. Diamond's "duplexer" for 146/222 MHz is rated at 150 watts, and this is more understandable. In any case, most hams operating VHF-FM would have little reason to exceed the 150 watt power level at the antenna feed point.

The X-2200A is an impressive package. It has a rugged look and, because the metal elements are entirely enclosed in Fiberglas tubing with a very weatherproof mid-section connector (used to join the upper and lower sections in the field), it should be extremely weather-resistant. The only exposed metals are aluminum, stainless steel and plated brass. Mounting hardware is all stainless steel (U-bolts, lockwashers and nuts) and should be completely impervious to the weather. I've had my F-23A installed at a hilltop repeater site for more than two years and the entire antenna is still "shiny." Viewing the mounting hardware through powerful binoculars, I can see it is all still "shiny," too.

Gain

Lacking an adequate calibrated reference antenna I could not measure the gain of the X-2200A. By computer analysis it seems that its gain on 146 MHz and 222 MHz are somewhat lower than Diamond's claims. But I should note here that most omnidirectional gain antennas for VHF/UHF seem to have published gain figures that aren't particularly accurate.

More important factors are radiation angle, bandwidth, good impedance matching, ease of assembly and installation, ruggedness and reliability, and overall cost effectiveness. In these areas, the Diamond products, including

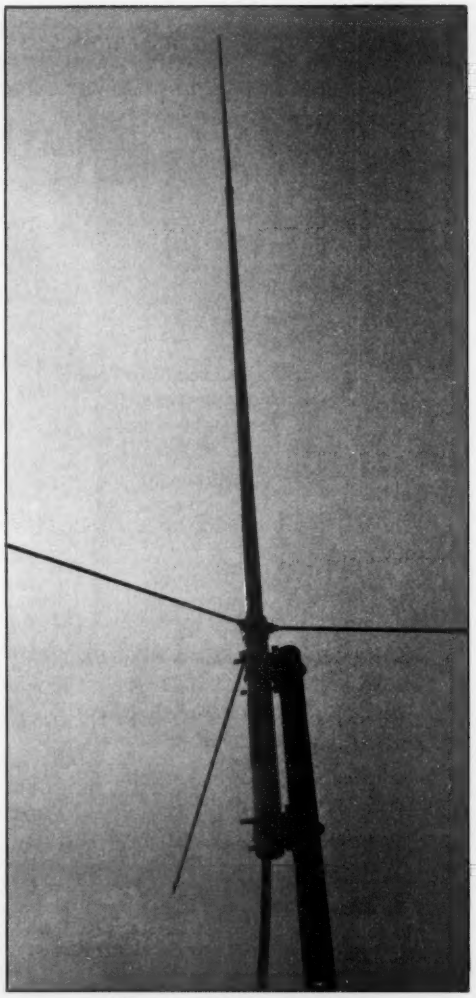

Photo A. The Diamond X2200A.

the X-2200A, definitely excel.

Since I couldn't measure gain, the only test I could run on the X-2200A was to compare it (on 2 meters) with my own personal reference antenna, an extremely popular all-aluminum stacked 5/8 wavelength radiator design with a tapped aluminum matching network at its base. It's a product that's been on the market for many years and still sells very well. The *claimed* gain (by its manufacturer) for my reference antenna is 6 dB and it is 10 feet tall, like the X-2200A. All things being equal, the Diamond X-2200A and my reference antenna should have worked about the same. Did they?

In a word, no. The dual-band X-2200A produced stronger signals (received and transmitted, in all directions and at various distances) than my reference antenna did. To make the comparison fair, I installed both antennas at the same height above ground (30 feet), and they were separated by 60 feet, which is nine wavelengths at 2 meters. Both antennas were fed by identical lengths of identical coaxial cable. At this writing, I still have both antennas installed and am still making comparisons. Because I live on a bit of a rise and am pretty high above average terrain for these parts, both antennas have a good "view" with a distant horizon ranging from 12 to 40 miles in most directions.

I am blocked in to the north by a mountain with an elevation of 3,600 feet, cresting only four miles from me, so I never expect great results from the north on VHF. But the other directions are more open, and I can always work into San Diego, some 120 miles to the southeast, with very low power on 2 meters. Working into Santa Barbara, some 65 miles to the west-northwest, is quite another story. In that direction, I have rugged coastal mountain terrain along the whole path and signals, while workable, are not terribly strong.

I took signal level data on various repeaters in all directions and recorded it on paper, using first my reference antenna and then the X-2200A. I took the data using S-unit signal levels on my FT-736R Yaesu VHF-UHF all-mode base station rig. S-meters being what they are, I don't believe the readings have any merit other than to compare one signal level to another. I then used my Hewlett Packard 608F signal generator, which has an output level accuracy of better than 1 dB at all levels and an output attenuator accuracy of better than 0.1 dB when comparing two levels that are less than 10 dB different, to determine what the different S-meter readings really meant.

Conclusion? The X-2200A outperformed my reference antenna by a peak of 3.1 dB, a minimum of 0.8 dB and an average of 1.95 dB. Pretty good for a dual-band antenna that has essentially the same aperture as the reference. I could not run the same set of tests on 222 MHz as I lacked an appropriate reference antenna. But the antenna does work well on 1.25 meters, and allows me to access the "CONDOR" 222 MHz linked repeater system very well through any of three "CONDOR" sites ranging from 20 to 70 miles away, using a Kenwood TH-315A handie-talkie (2.5 watts output). In all, I'm pretty impressed.

VSWR

The VSWR of the X-2200A is low, low, low. Since I'm using a 100-foot-long transmission line to reach the antenna and it has about 1.4 dB loss on 146 and 1.8 dB loss on 222 MHz, taking VSWR data in the shack would prove rather useless: The loss of the cable reduces the measured VSWR. So I measured VSWR across each band right at the antenna feed point with zero transmission line loss, and this data is shown in Table 1. I took the VSWR data with the antenna temporarily installed on a mast mounted in a small tripod sitting in my driveway, prior to installing the X-2200A on its permanent mounting. Raising the antenna another 20 feet or so higher shouldn't change the readings.

The X-2200A is supplied with mounting hardware that will accommodate mast diameters from 30 to 62 mm (about 1.2" to 2.4"), which should allow convenient installation by almost anyone. I like this much better than the mounting system on my reference antenna, which calls for plugging the base of the antenna into its mounting mast and only allows for a maximum mast diameter of about 1.3 inches. When mounting the X-2200A or any similar omnidirectional vertically-polarized antenna, be sure that the mounting mast does not protrude beyond the base of the antenna (where the radials attach) or performance will be severely degraded. This antenna should *not* be side-mounted on a tower unless it can be spaced at least 40" from the tower. Even with this spacing, the pattern will not be quite omnidirectional.

The Diamond X-2200A packs a lot of punch! It is another excellent product offered by a world-class manufacturer who is sensitive to the needs of American hams. 73

Table 1.
Measured VSWR vs. Operating Frequency, Diamond X-2200A

Frequency in MHz	VSWR
144	1.63:1
145	1.39:1
146	1.13:1
147	1.22:1
148	1.50:1
222	1.28:1
223	1.26:1
224	1.40:1
225	1.62:1

Notes: There are no field tuning adjustments for the X-2200A. It appears that this particular antenna was resonant towards the low-frequency end of the 1.25 meter band and could possibly be adjusted for lower VSWR at the upper end by slightly shortening the brass radiator length, but no attempt was made to do so. VSWR data taken with 12" feedline and directional coupler at the base of the antenna; measurements made in the shack at the end of a normal transmission line would indicate the VSWR to be lower.

73 Review

by Larry Antonuk WB9RRT

Quickyagi Antenna Design Program

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Put three hams in a room, and you'll wind up with four opinions on any given topic. While we share one of the most diverse hobbies on earth, it may be safe to say that one thing all hams have in common is antenna building. It's hard to find a ham who hasn't built at least one antenna—even if it's only a 10 meter dipole, or a 2 meter ground plane made from a coat hanger. The antenna is the interface between the rig and the ether, and an understanding of antennas (and antenna problems) is the common ground we all stand on. While virtually every ham has built some kind of antenna, it's also a safe bet that perhaps only one in 20 antenna builders has ever built a yagi.

How come? Several reasons come to mind. While it's pretty easy to figure the length of a 2 meter dipole, figuring out a 2 meter beam is a little trickier. Not only are you concerned with frequency and length, but you have to worry about the spacing between the elements. Which, of course, changes if you change the diameter of the rods. Which, of course, all changes if you want to add more elements. Which, of course, is not to mention trying to get your design to work best for a given front-to-back ratio. Or for a given bandwidth. Which, of course, means you might want to change the length a little and . . . Phew! This could be more complicated than it's worth.

Not only that, but if you do find a published design somewhere that includes more or less about what you want from your yagi, you still have to put it all together, which is a fair amount of work. Not that that's a problem, but it does represent a commitment of time and effort. If the design calls for 3/8" tubing, and you use the 1/4" stuff you have in the basement, will it still work? Is it worth the effort if you're not sure?

Once the thing is all screwed together and you want to test it . . . that's kind of tricky, too. Unless you're building scale models and have an anechoic chamber in the basement, it's pretty hard to get meaningful test results—especially on parameters like bandwidth and front-to-back ratios. You might even be able to do some A-B comparisons with your buddy across town, but who wants to build up two separate antennas just to try out a couple of new ideas?

Design, Quick and Easy

The answer to all of these problems lies in the ability to calculate your own yagi designs, based on the parameters you want, using the materials that you may have available. Yagi design was originally accomplished using the published NBS designs, which were put together using a combination of design and experimentation. Eventually software was developed that performed the calculations on an as-needed basis, but this was normally available only on a time-sharing basis on university mainframes. Once the desktop computer boom hit, it became viable for small companies to write the complex code needed to perform the thousands of calculations, and to offer it to the casual experimenter.

RAI Enterprises has taken this concept a step further. By writing the essential calculating routines in machine language, the Quickyagi program produces results in record time, while maintaining the user-friendliness of higher level languages. (For users new to antenna design software, the "BLAZING SPEED" referred to on the Quickyagi brochure means an antenna design in as little as a few minutes, up to a few hours. Obviously, this changes depending on whether you're using a Pentium or a PC JR, but in any case it beats the usual "enter the parameters, and go away for the weekend" software you may be used to.)

Perhaps the easiest way to get to know Quickyagi is to run the Auto Design feature, which creates the yagi design with a minimum of information. Starting the Auto Design mode is accomplished with two keystrokes after the opening menu. The user is then prompted for the design frequency, the number of elements desired, and the diameter of the available elements. After a few seconds, the program returns with the antenna gain, front-to-back ratio, length, and input impedance. The user is then prompted to choose between maximizing the front-to-back ratio, or maximizing the gain for a given front-to-back ratio. If the second option is chosen, the user may pick from several more options—best gain while choosing the front-to-back ratio, optimum gain, or optimum bandwidth. Once all of the selections are made, the program goes into the "thinking" mode. This

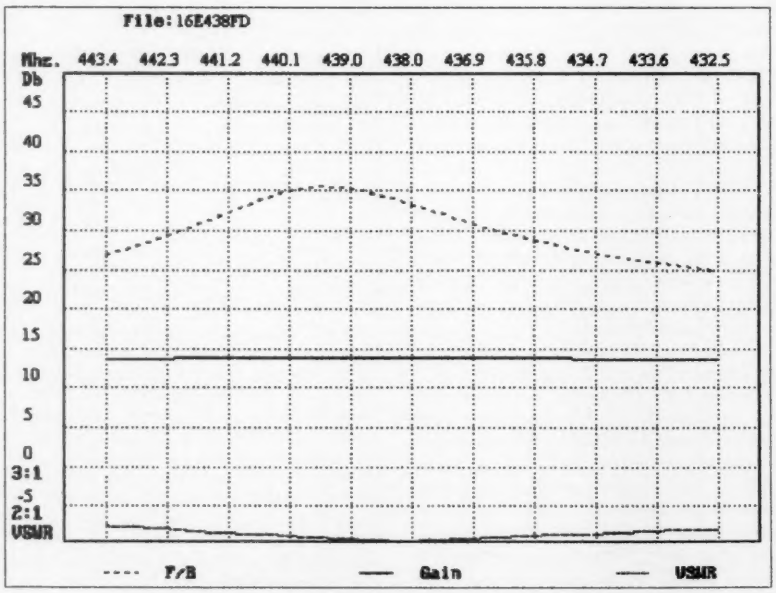


Figure 1. Performance vs. bandwidth graph.

can take several minutes to several hours, depending on the machine and the antenna design being performed. (Again, due to various machine configurations, time comparisons may be somewhat meaningless. However, a six-element 146 MHz yagi took about 15 minutes to optimize on a '286 clone. *[Manufacturer's Note: The '286 clone was running without a math coprocessor. The results will be up to four times faster with a coprocessor.]*)

Once the design is optimized, it may be evaluated in several ways. Quickyagi will draw a full-screen polar plot of the antenna gain, in either an elevation or azimuth mode. Linear or logarithmic scales are available in either case. These plots can be viewed on-screen, or sent to the printer for later examination. A Bandwidth Chart Utility displays the bandwidth information (gain, F:B, impedance, and VSWR at 21 frequencies) in chart or x-y graph mode. Again, these can be printed in hard copy and saved. Antenna designs can be saved to disk, and pulled up later for further design and testing.

In addition to the Auto Design mode, the program also supports manual entry of various parameters, and will calculate the missing features. For instance, you might need to design a yagi to make use of that bundle of 5/16" aluminum you dragged home. You might have a 10-foot section of square tubing that would make a nice boom. What is the best arrangement of elements to give you maximum gain on 440 MHz? Quickyagi can let you know. A Scaler routine allows scaling an existing design to a new frequency, by changing either the element lengths, or the lengths and the spacing. (Remember that high-class five-element yagi you bought at the last hamfest? The one that turned out to be on 155.000 MHz? These last two features are just the ticket to tell you if you can just lengthen the elements, or if you have to move them . . . or if you threw 25 bucks down the drain!) Options are available that calculate element lengths using tapered elements, for the use of telescoping tubing, plus element compensations for the boom, the ability to view the antenna's geometry, and the ability to easily model a folded dipole driven element. In case you only associate yagis with VHF and above, note that Quickyagi can calculate designs from 1.5 to 999 MHz, with up to 17 elements. (Please check your local zoning regulations before building that 160 meter, 17-element beam.) Even if you don't plan on building any HF beams, Quickyagi will gladly calculate wire beam dimensions for use on Field Day, or during emergency operations. The best part is that Quickyagi doesn't assume anything—just tell it about your resources and it will design a yagi that will work for you.

The Quickyagi program comes with "on-disk" documentation, which means you won't get a fancy hard-cover manual. The manual will, however, be up-to-date, which is somewhat of a rarity these days. In any case, the manual amounts to a half dozen pages, due to the ease-of-use of the program itself.

The Quickyagi program qualifies as a low-priced piece of software, but could just be your key to a new realm of antenna building. By removing the mystery from yagi design, it allows antenna experimenters to get involved with "from scratch" designs using materials they already have on hand. "What if" comparisons can be performed by modeling existing yagis, with the idea of performing modifications, or just for the fun of it. Existing antennas can be modified for different frequency ranges, which open up a great source of antenna materials—the surplus commercial market. If you build even one yagi a year, you'll find Quickyagi to be well worth the money.

(Quickyagi runs on any XT or better with at least 640K of RAM, using CGA, EGA, VGA, or Hercules graphics. A math coprocessor is supported but not required.)

[Manufacturer's Note: The program is now optimized to run on an AT or later models of the "Turbo" XT running the NEC V-20 microprocessor. A math-coprocessor-only version is available by special order, at no extra charge, for the older 8088 PC/XT.]

A Sensitive Bandspread SWL Receiver

Aaah, the nostalgiac smell of dust burning off tubes!

by Eric R. Johnson XE2/KB6EPO

Back in the 1920s and during the Great Depression era, the home-brew regenerative shortwave receiver was all the rage. Radio was coming of age and everyone wanted to listen in. Money was tight and although most commercially made radios were of the regenerative type, they were still too expensive for the average consumer. Yet the low parts count of the regenerative receiver made construction a snap and kept costs down, keeping this type of receiver popular with the home-brewer right up to the 1960s. And the regen's sensitivity was hard to match by all but the best superheterodyne receivers of the time. These attributes still hold true today!

This little radio can "hear" everything on the SWL bands that my Yeasu FT-747 can! An 8-foot piece of wire strung out along the test bench or behind the desk is more than enough to pick up all the major broadcasters. Of course, the more antenna the merrier—but the point is that excellent reception is possible with an indoor antenna right at your listening position. The three-stage circuit is typical of a "deluxe" setup of the era. The physical size is less than half of what someone in those days might have constructed using the same schematic, thanks to the substitution of "modern" miniature tubes and components.

I have departed from our theme era in the design of the power supply in order to make the receiver completely portable. In the old days they used bulky, non-rechargeable "A" and "B" batteries to provide filament and plate voltages. The super deluxe setup sported a line-operated transformer and vacuum rectifier "B battery eliminator," the use of which often required the owner to replace all the existing "DC filament" tubes in the radio with "modern AC filament" tubes. Portabili-

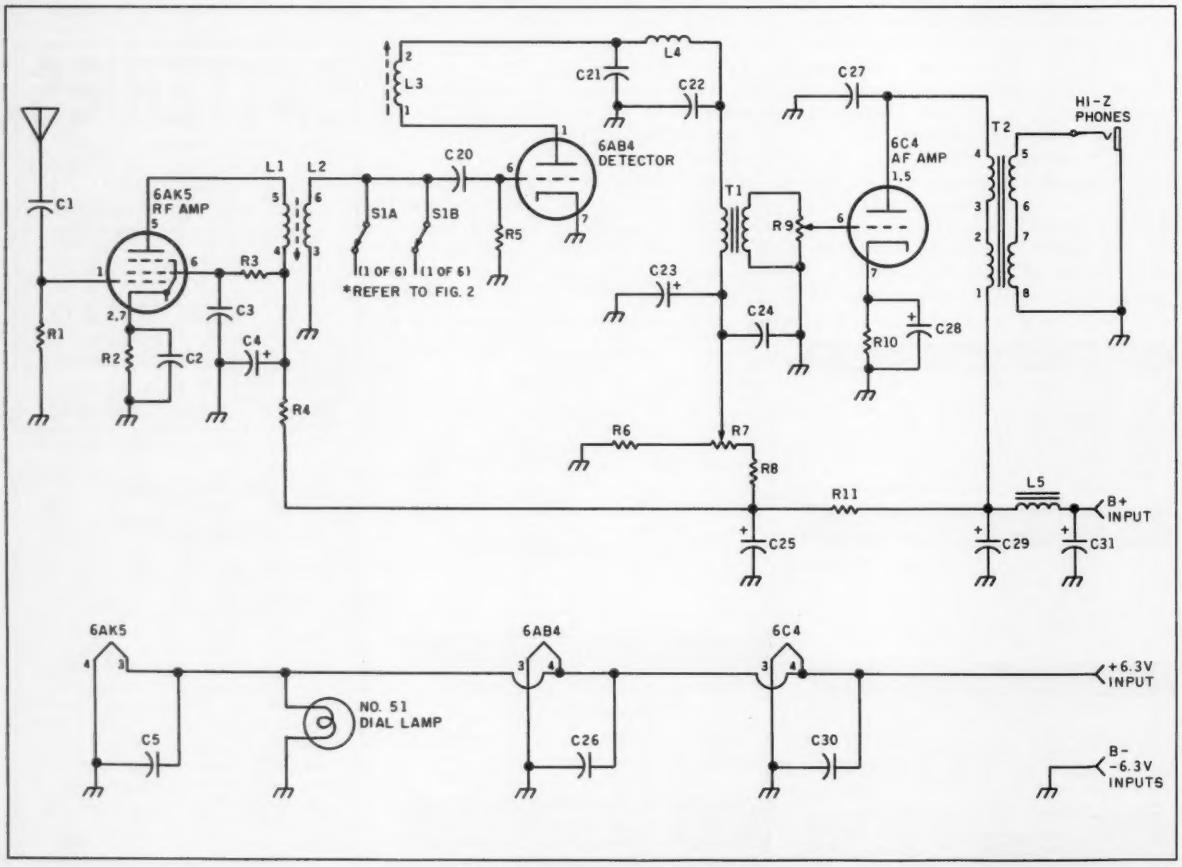


Figure 1. Receiver schematic diagram.

ty was either tedious or impossible. My power supply allows portable operation for about 10 hours from a single 6 volt, 10 amp-hour rechargeable sealed lead-acid battery (gel cell). When connected to the AC line it both operates the radio and charges the battery.

Receiver Theory of Operation

The receiver (Figure 1) consists of an untuned pentode radio frequency amplifier, a triode regenerative detector, and a power triode audio frequency amplifier. Output is into a pair of high impedance headphones, either 2k ohm magnetic types or the crystal type. Both are readily available on the surplus market. Those "extra" resistors and capacitors you see sprinkled liberally throughout the schematic are for bypassing and B+ line decoupling filters. They should not be left out of the circuit as a way to save money! These parts are what make the difference between a "sweet" stable and predictable regenerative receiver and a wild untameable howling "beast" of a receiver.

The RF Amplifier

The 6AK5 is a sharp-cutoff pentode designed for use in RF or IF amplifiers in high-frequency wideband applications at frequencies up to 400 MHz. Its primary purpose is to isolate the antenna from the tuned circuit in the detector's grid. This eliminates the detuning problem found in regen sets where the antenna is coupled directly to the detector. In spite of this being an untuned amplifier, and thanks to the use of the pentode, we still get about 6 dB of gain on all the bands. C1 couples the antenna to the control grid. L1 couples the amplified output to the detector.

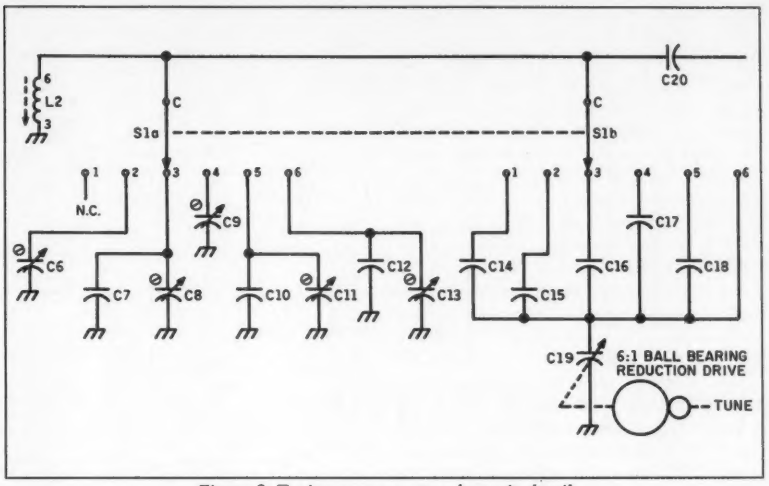


Figure 2. Tuning components schematic detail.

The Regenerative Detector

The 6AB4 is a high-mu triode designed for use in cathode-drive amplifiers, frequency converters, and oscillators at frequencies up to 300 MHz. Electrically identical to one section of dual-triode type 12AT7, here it is used as a regenerative detector. L2 and the capacitors selected by S1 form the only

tuned circuit in the radio. C20 couples the selected signal to the control grid and, along with R5, forms a grid-leak bias circuit. The amplified RF signal is coupled by L3, in phase, back to the tuned circuit L2/S1. This causes two effects: The signal is re-amplified, thus giving extreme sensitivity, and it introduces "negative resistance" into L2, which dramatically increases it's "Q." This allows our single tuned circuit to give our radio a selectivity on the order of 3 kHz. C21 is the return path for the RF signal. The same signal is detected by grid-leak action and the amplified audio is developed across the primary of T1. L4 and C22 filter any residual RF from the detected audio. Of course, all this must be controlled somehow or else we'd have an RF oscillator instead of a detector! R6, R7, and R8 form a voltage divider to provide variable B+ voltage to the detector. C24 filters out any noise generated by the mechanical motion of R7. In use, R7 is advanced until the tube oscillates (which can be heard in the headset), and then backed down until oscillation just stops. The circuit is now set up for best sensitivity and selectivity for AM signals.

The Tuning System

Now refer to Figure 2. L2 and the capacitors selected by S1a and S1b form the tuned circuit in our radio. Six shortwave bands are

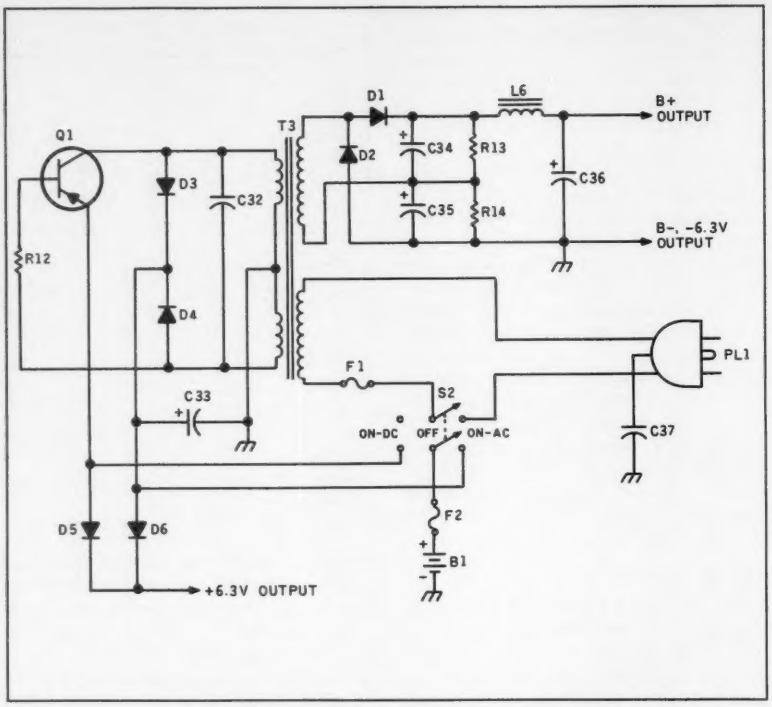
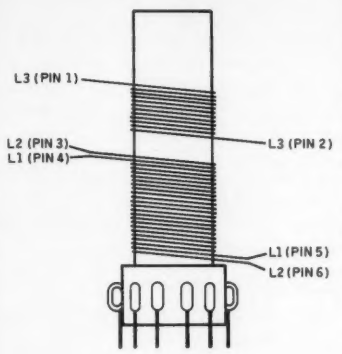


Figure 3. Power supply schematic diagram.



L1 - 14 TURNS, CLOSEWOUND BETWEEN L2 TURNS.
L2 - 15 TURNS, SPACED BY L1.
L3 - 12 TURNS, CLOSEWOUND, WINDING SPACED 1/8" FROM TOP OF L1/2.

* USE NO.26 ENAMELLED WIRE FOR ALL 3 INDUCTORS.

** CORE IS 1/4" DIA. BY 1 1/8" LONG PHENOLIC, WITH 2 FERRITE SLUGS. CORE BASE SECTION IS 1/2" DIA. BY 3/8" LONG, WITH 6 SOLDER LUGS IMBEDDED.

Figure 4. Coil winding diagram.

selected by S1 as follows:

Position 1 = 13 Meter Band, 21.200 - 22.000 MHz
Position 2 = 16 Meter Band, 17.400 - 17.980 MHz
Position 3 = 19 Meter Band, 15.000 - 15.580 MHz
Position 4 = 21 Meter Band, 13.400 - 13.900 MHz
Position 5 = 25 Meter Band, 11.600 - 12.075 MHz
Position 6 = 31 Meter Band, 9.450 - 9.900 MHz

S1a performs the function of "bandset." Capacitors C6 through C13 are either fixed silvered mica or miniature silvered ceramic trimmer capacitors. S1b selects various capacitors to be placed in series with bandspread/main tuning capacitor C19. C14 through C18 are fixed silvered mica types. C19 is a 25 pF air-dielectric variable capacitor with a standard 1/4-inch shaft. Between it and the tuning knob is a 6:1 ball bearing reduction drive to which is attached a 4-inch diameter aluminum plate that serves as the tuning dial.

In a tuned circuit with a fixed inductance, a variable capacitor will have a greater effect on tuned frequency the higher the frequency. S1b introduces ever smaller fixed capacitors in series with C19, effectively reducing its overall change in capacitance each time the bandswitch is moved to a higher band. This ensures that the entire 180 degrees of rotation on the tuning capacitor is used to tune each band, keeping the stations from being bunched up in a small area on the dial. With this system the 6:1 reduction drive is not really necessary, but I had a few laying around so I used one anyway.

The AF Amplifier

The 6C4 is a medium-mu power triode designed for use in Class C RF amplifiers. It is capable of 5.5 watts of output at frequencies in the 50 MHz range. It is used here because of its low plate and filament current requirements compared to a power pentode. This is important since we want to be able to operate the radio on battery power for long periods of time. The audio output is louder than I can stand with the volume control advanced halfway on most signals. T1 is a step-up audio transformer with a ratio of 1:2.5. R9 is the volume control. T2 matches the output impedance of the 6C4 to the headphones.

Power Supply Theory of Operation

The heart of the power supply (Figure 3) is transformer T3. And the good news is that it's nothing special! It has two 6.3 volt 2 amp secondaries, and two 115 volt primaries. A 12.6 volt transformer with two primaries would work just as well. For both AC and battery operation, we use one of the primaries to provide the B+. D1, D2, C34, and C35 form a full-wave voltage doubler. L6 and C36 smooth the rectified output.

During AC operation, one half of DPDT toggle switch S2 routes the line voltage to the other primary of T3 via F1. C37 connects the line ground to the circuit ground. The two 6.3 volt secondaries, D3, D4, and C33, form a full-wave power supply that produces 6.3 volts DC at 4 amps (under load). D6 routes this voltage to the filaments and the dial lamp, which use up 0.55 amps of the available current. The other half of S2 routes this voltage to B1 via F2, making available up to 3.45 amps to charge the battery. There is no danger of overcharging the battery because the voltage is within the acceptable range for continuous "float" charging. D5 ensures that Q1 and R12 have no effect on operation, effectively disconnecting them.

During DC operation, current from the battery is routed through F2, one half of S2, and D5 to provide power for the filaments and dial lamp. At the same time, current from the battery is used to operate the power oscillator consisting of Q1, R12, and both secondaries of T3. C32 shapes the waveform so that it is closer to being a sine wave than a square wave, thus eliminating the switching transients present in a square wave which are difficult to filter out. The 115 volt AC current generated in the unused primary of T3 is isolated from PL1 by S2, thereby eliminating a shock hazard there. Because of the way they are connected, D3, D4, C33, and D6 are effectively "not there" during DC operation.

Construction Hints

The heart of the receiver is the L1-3 coil assembly. You'll have to wind it yourself. Figure 4 shows how it's done. The coil form was found at a surplus store, and the winding that was on it had to be removed first. As previously mentioned, the output of the 6AB4 must be fed back in phase to its grid in order for it to oscillate. If the coil is wound and connected as shown, feedback will be in phase. A handy rule of thumb to keep in mind goes as follows: If L2 and L3 are wound end-to-end in the same direction, the plate connection is to the outside of the plate or "tickler" coil (L3) when the grid connection is to the outside of L2. If you lose track of the leads and the detector fails to oscillate after being wired, swapping the two leads of L3 will fix the problem. The other consideration is to make sure that when laying out your parts-mounting plan, the coil assembly is separated by at least one coil diameter from any large metal objects (such as the front panel or an audio transformer). This prevents any such object from ruining the high "Q" of the coil.

If you can't find any audio transformers for T1 and T2, you can substitute resistors and capacitors without losing too much audio gain. To substitute for T1, replace the primary with a 250k ohm resistor and connect a 0.01 uF capacitor from the junction of that resistor and C22 to the top of volume control R9. To substitute for T2, replace the primary with a 47k ohm resistor and connect a 0.1 µF capacitor from the plate of the 6C4 to the headphone jack. If T2 is replaced by R/C coupling then C27 may be omitted also.

L5 and L6 are not critical. Anything from 2 henries on up should work fine. If you don't have an inductance meter, just use an ohmmeter to find one that measures between 150 and 700 ohms. The current through these is only 18 mA, so anything small in size that fits either of the above specifications will work. It can be a choke or the primary of an old tube-type audio output transformer. I used the latter for mine. They measured 4.5 henries on the inductance meter, and 150 ohms on the ohmmeter.

A regenerative detector occasionally shows a tendency to change frequency slightly as the hand is moved near the dial. This condition (body capacity) can be corrected by better shielding. I used double-sided PC board material for the front panel and receiver sub-chassis. The front panel is 10-1/2 inches wide by 6-1/2 inches high. The receiver sub-chassis is 9 inches wide by 4-1/2 inches deep, and is soldered at a right angle to the center of one side of the front panel. This results in a "T"-shaped assembly that is very strong. Once all the controls are mounted on the front panel their metal mounting bushings make contact with the copper on both sides of the panel, thereby providing double shielding. With this technique there is no body capacity and the receiver is completely stable. The tube sockets and all the other parts are mounted on the sub-chassis after appropriate sized holes are made. Wiring is done point-to-point, with the advantage that wherever a ground is required it can be soldered to the sub-chassis with minimal lead length.

You could develop your own PC artwork for the receiver sub-chassis and etch it before soldering to the front panel if you like. When making your layout for the receiver, the important thing to consider is to keep all leads and/or PC runs as short as possible between the plate of the 6AK5, L1/2/3, S1 and its associated capacitors, and the 6AB4. Any layout you can come up with that accomplishes this goal will work fine.

The power supply was also built on a piece of PC board material measuring 7-1/2 inches long by 3-1/2 inches wide. You could etch a pattern for this if you like, but it's not necessary. The power switch is a three-position "ON-OFF-ON" type, and is mounted on the front panel. Q1 is mounted on a small heat sink just slightly larger than the area of the transistor body and about 1 inch tall. The transistor runs cool to the touch even after hours of operation. R12 will probably need to be experimented with if you use a different transistor or transformer. You'll find the right value will be somewhere between 100 ohms and 1k ohm.

I built a box out of standard 1-inch appearance pine, like you would use to make shelves out of, and finished it with polyurethane varnish. The battery and power supply mount inside it towards the rear, and the receiver/front panel assembly slides in the opening on the front and is secured by several wood screws with wide decorative heads. A short cable with a plug on it connects the power supply to a socket on the receiver. The line cord and antenna jack are on the back of the wood box, and the antenna jack connects to the receiver through a short coaxial cable and RCA plug. Four rubber feet screwed into the bottom of the box finish it off, and the end product looks real "olde-tyme."

Table 1 lists all the parts, additional substitution information where allowable, and sources of parts for those who do not have any decent stores nearby.

Calibration and Operation

All calibration is done with the aid of a signal generator. It is not necessary to make a direct connection between the receiver and the signal generator. A short piece of wire connected to the output of the signal generator will radiate enough signal to be picked up by the windings of L2. Set the top (L3) slug in the coil form so that it's flush with the top of the form, then calibrate in the following order.

1. Band 1 (13 M). Set the tuning capacitor, C19, to its fully unmeshed position. Set the signal generator for 22.000 MHz. Adjust the bottom (L2) slug in the coil form until you can hear the signal best.

2. Band 2 (16 M). Leave C19 set as it is. Signal generator to 17.980 MHz. Adjust C6 for best signal.

3. Band 3 (19 M). Adjust C19 to the fully meshed position, then open it up just a tad. Signal generator to 15.000 MHz. Adjust C8 for the best signal.

4. Band 4 (21 M). Return C19 to the fully unmeshed position. Signal generator to 13.900 MHz. Adjust C9 for best signal.

5. Band 5 (25 M). Leave C19 set as it is. Signal generator to 12.075 MHz. Adjust C11 for the best signal.

6. Band 6 (31 M). Adjust C19 to the fully-meshed position. Signal generator to 9.450 MHz. Adjust C13 for the best signal. Now that the band edges have been defined, you can go back and and mark whatever calibration intervals you wish for each band on your tuning dial. I painted my dial white, then used black dry transfer numbers for this.

To listen to stations, connect an antenna and select a band with S1. Set the volume control at mid-range, then adjust the regeneration control (R7) until the detector breaks into a "hiss," which indicates oscillation. Slowly reduce the regeneration control until the "hiss" just stops. You should now be able to hear stations as the tuning control is rotated. Sometimes the setting of the regeneration control needs to be changed to maintain the "sweet spot" from one end of the tuning dial to the other within the same band. If you are hearing beat notes as you tune across stations, the regeneration control is advanced slightly too far for best AM reception. This is a good way to find stations, but once you've got one tuned in to "zero beat," reduce the regeneration control a tad

and you'll be in the "sweet spot" where sensitivity, selectivity, and fidelity of detected audio are all at their best.

The detector will require more voltage from the regeneration control (R7) in order to oscillate on the 31 meter band, and less voltage to oscillate on the higher bands. If it will not oscillate sufficiently on the 31 meter band, you can either turn the top (L3) slug in the coil form in until oscillation is enough, or play with the values of R6 and R8. When everything is set up right, the regenetation control will be one-quarter of its rotation from the ground end for reception on the 13 meter band, three-quarters of it's rotation from the ground end for reception on the 31 meter band, and somewhere in the middle for all the other bands. My receiver needs 16 volts from R7 to work on the 13 meter band and 60 volts to work on the 31 meter band.

To recieve signals below the 31 meter band, you will need to make your L1/2/3 coil larger (more inductance), and experiment on your own with the values of the capacitors selected by S1. You'll also want to use a larger capacitor for C19, say 50 pF, in order to get sufficient bandspread on the lower frequencies. With the coil specified in Figure 4, you cannot receive well below the 31 meter band. This is because the regenerative receiver likes to have a high "L" to "C" ratio in its tuned circuit. Adding more capacitance to make the specified coil tune below the 31 meter band ruins the high "L" to "C" ratio, resulting in a receiver that needs excessive voltage from R7 in order to oscillate and ruining the high selectivity of the circuit.

If you decide to calibrate the receiver for the ham bands instead of the broadcast bands, you'll find that CW is easy to copy. To receive CW, the regeneration control is set so that the detector is just starting to oscillate. This provides "autodyne" reception. The code signals can be tuned in and will give a beat note with each signal depending on the setting of the tuning control. As the receiver is tuned through a signal, the tone first will be heard as a very high pitch, then will go down through "zero beat" and rise up again on the other side, finally disappearing at a very high pitch. The same setting of the regeneration control used for CW reception will also allow SSB to be copied. Tuning will be very critical, but is easy to do with the help of the 6:1 ball reduction drive.

Whatever bands you calibrate your receiver for, a few moments practicing tuning-in stations will get you familiar with the way a regenerative receiver operates and soon you'll be an old pro at it. I guarantee that if you've never played with one of these sets before, the more you listen around the bands the more you'll be amazed at what a small handfull of parts in a simple circuit can do. And just maybe you'll get to feel a little of what it meant to be a "real ham" in the "old days" when "everyone built their own rigs" from whatever they could find laying around! 73

See Parts List on page 38

Continued from page 37

Parts List

Part	Description	Source (see key below)	Substitution Range
B1	6 volt, 10 Ah gel cell	2	Larger current capacity
C1	56 pF, 500V ceramic disk	1,2	33-100 pF
C2	0.02 µF, 25V ceramic disk	1,2	0.01-0.1 µF
C3,24	0.02 µF, 500V ceramic disk	1,2	0.01-0.1 µF
C4,25,31	10 µF, 400V electrolytic	1,2	10-100 µF
C5,26,30	0.15 µF, 50V ceramic disk	1,2	0.01-1 µF
C6,8	6-25 pF ceramic trimmer	2	None*
C7,14	15 pF, 500V silver mica	1,2	Ceramic NPO type*
C9,11,13	10-40 pF ceramic trimmer	2	None*
C10,16	30 pF, 500V silver mica	1,2	Ceramic NPO type*
C12	68 pF, 500V silver mica	1,2	Ceramic NPO type*
C15	20 pF, 500V silver mica	1,2	Ceramic NPO type*
C17	39 pF, 500V silver mica	1,2	Ceramic NPO type*
C18	62 pF, 500V silver mica	1,2	Ceramic NPO type*
C19	25 pF air variable	1,2,3	None*
C20	100 pF, 500V silver mica	1,2	47-220 pF
C21	270 pF, 500V silver mica	1,2	220-390 pF
C22	2500 pF, 500V silver mica	1,2	680 pF-3300 pF
C23	2.2 µF, 250V electrolytic	1,2	1-5 µF
C27	0.0015 µF, 500V ceramic disk	1,2	750 pF-0.0022 µF
C28	100 µF, 50V electrolytic	1,2	10-150 µF
C29,34,35	100 µF, 400V electrolytic	1,2,3	50-220 µF
C32	2 µF, 150V non-polarized	2,3	0.5-4 µF non-polarized
C33	1000 µF, 16V	1,2	470-5,000 µF
C37	0.1 µF, 400V	1,2	0.047-0.68 µF
D1,2	600 PIV, 1A RS#276-1104	5	Any equivalent
D3,4,5,6	50 PIV, 3A RS#276-1141	5	Any equivalent
F1	FO250V 3/8A	1,3	None
F2	FO250V 4AS	1,3	None
L1,2,3	Handwound on 1/4" form	1,2	None* (see Figure 4)
L4	4 µH RF choke	1,2,3	2.5-10 µH
L5,6	5H; 150 ohms DC choke	1,2,3	See text
PL1	3-wire line cord set	1,2	
Q1	MJ2955	5	RS#276-2043
R1	560k ohm, 1/2W	1,2	100k-1 MEG
R2	330 ohm, 1/2W	1,2	100-560 ohm
R3	22k ohm, 1/2W	1,2	18k-27k
R4	4.3k ohm, 1/2W	1,2	2.2k-5.6k
R5	3.3 megohm, 1/2W	1,2	1 MEG-4.7 MEG
R6	10k ohm, 1/2W	1,2	1k-10k
R7	50k ohm, 1/2W pot.	1,2,3	100k pot.
R8	27k ohm, 1/2W	1,2	10k-33k
R9	250k ohm, 1/2W pot.	1,2,3	100k-500k pot.
R10	2.4k ohm, 1/2W	1,2	1.8k-3.3k
R11	1k ohm, 1/2W	1,2	1k-4.7k
R12	560 ohm, 1/2W	1,2	See text
R13,14	470k ohm, 1W	1,2	220k-1 MEG, 1W
S1	2-pole, 6-Position rotary	2,3,4	
S2	DPDT "ON-OFF-ON" toggle	2,3,4	
T1	Audio transformer, UTC #TF5SX21ZZ, 1:2.5 ratio pri = 1k ohm DC, sec = 6.5k ohm DC	1,2,3	See text
T2	Audio transformer, UTC #TF4RX13YY, pri Z = 10k, 790 ohm DC sec Z = 2k, 195 ohm DC	1,2,3	See text
T3	STANCOR #P-6376 dual 115V primaries dual 6.3V, 2A secondaries	2,3	See text
V1	6AK5 sharp cut-off pentode	1,3	6AJ5,5595,5654,EF95
V2	6AB4 hi-mu triode	1,3	6664,EC92
V3	6C4 power triode	1,3	5610,6100,6135,EC90
Miscellaneous:			
(3 ea.)	7-pin miniature socket	1,2,4	
(1 ea.)	6:1 ball bearing drive	2,4	**
(1 ea.)	Bayonet lamp socket	1,2	**
(1 ea.)	#51 miniature lamp	1,2	**
(1 ea.)	HI-Z headphones military styles H-43B/U, H-23B/R, HS-16, or equiv.	1,2,3	See text

Substitution Notes Key:
none = Do not substitute or omit for safety reasons.
none* = Values may be changed to tune different bands.
Values may need to be varied slightly to tune specified bands due to differences in stray wiring capacitances between your model and the prototype.
** = May be omitted if desired.

Source Key:

1.) Antique Electronic Supply, 6221 S. Maple Ave., Tempe AZ 85283
(602) 820-5411; Fax: (602) 820-4643

2.) Gateway Electronics, Inc., 8123 Page Blvd., St. Louis MO 63130
(314) 427-6116
9222 Chesapeake Dr., San Diego CA 92123
(619) 279-6802

3.) Fair Radio Sales, P.O. Box 1106, 1106 E. Eureka St., Lima OH 45802
(419) 223-2196/227-6573; Fax: (419) 227-1313

4.) Surplus Sales of Nebraska, 1502 Jones St., Omaha NE 68102
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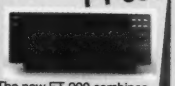
The new FT-990 combines the basic technical features of that top-of-the-line model with several new advances in both transmitter and receiver circuitry. Digital filter, 90 memories, wide dynamic range and much more!
SAVE $100 MORE!
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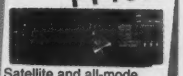
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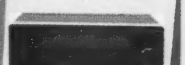
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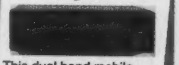
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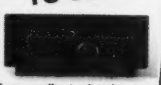
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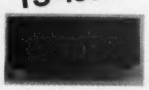
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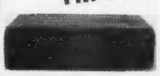
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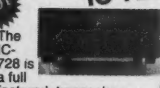
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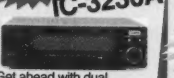
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A 2 Meter Half-Kilowatt for $1 per Watt

Build this VHF amp using vacuum-tube technology!

by Steve Katz WB2WIK/6

Everybody wants a stronger signal, and those operating 2 meters are no exception. In the car, it is economically feasible to run 170 watts RF output power or so on the 144 MHz band before the law of diminishing returns sets in. Solid-state "brick" amplifiers, which are powered by 13.8 volts DC, abound. These little amplifiers cost about $2 to $2.50 per watt new, and often include a built-in receiver preamp.

For the home station, tube-type amps are much more efficient than solid-state amps. Example: Let's say you intend to use a 170-watt-output "brick" amplifier at home, and its RF drive (input level) requirement is 30 watts to achieve full output. The amplifier requires a regulated source of 13.8 VDC, and draws 27 amperes at full power. To generate this 373 watts of DC power, you use a commercially-manufactured linear power supply that, to deliver 13.8V at 27A, requires an input of 117 VAC at 5 amperes. So, to run a measly 170 watts RF output power you are consuming 585 VA (volt-amperes, the AC equivalent of watts) every time you "push the pickle." To generate that 30 watts RF drive into the amplifier you are probably consuming at least 100 VA more. So, to run 170 watts RF output, you are consuming 685 VA of AC power, which is an overall efficiency level of about 25%.

The solid-state "brick" amplifier is a convenience which requires no tuning across the band, but its efficiency isn't very good, and gets *much worse* at lower power levels. If you want to run higher power, the overall cost of doing so will skyrocket into the $3+ per watt range as the regulated DC power supply requirements become unwieldly. I can understand using solid-state amps for the car, truck, boat, or RV, since the normal power is 13.8 VDC. But at home, when you use an outboard solid-state amp, you are first down-converting power from 117V (or 234V) AC to 13.8 VDC, then up-converting that to useful RF energy.

While modern "switch-mode" regulated power supplies are 90% efficient, most hams aren't using these because of their cost. Instead, they're using old-fashioned "series regulator" linear power supplies, which are terribly inefficient, wasting a lot of power as heat. Not only that, but the "no-tune" solid-state amps can only be optimized at *one* power level (typically the highest power they can run) and lose efficiency quickly as the power level is reduced. The no-tune solid-state amps will not allow you to transmit into a mismatched load, should you ever need to, because they all have VSWR protection circuits in them that shut down if the SWR gets high. Most also include a thermal overload protection circuit which shuts them off if they get too hot—and they *do* get mighty hot, especially under high duty-cycle service. Yuck! What's a ham to do?

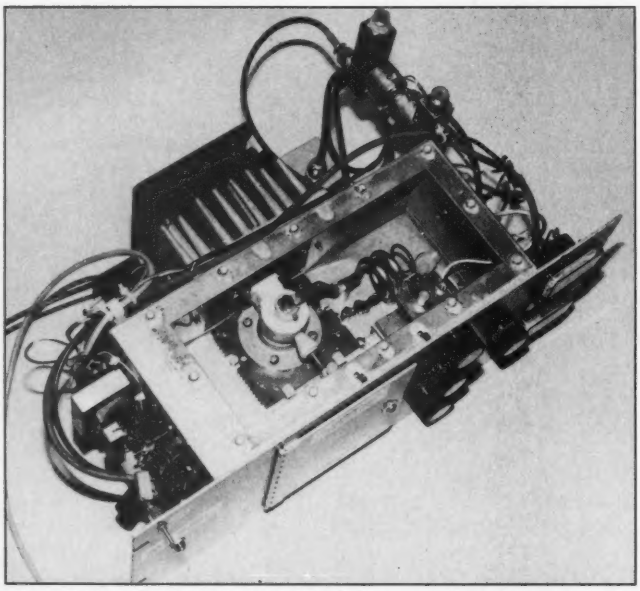

Photo A. Top view of the RF deck. The 8560A external anode tetrode is visible at center, with the plate tank circuit to the right.

Tube Amplifiers

How about taking a giant step backwards in technology and using a tube amplifier instead? Tubes are still heavily used in modern high-powered transmitters and amplifiers, and for good reason: They tend to develop more gain and operate at higher efficiency levels, especially at higher radio frequencies, than transistors do. Not only that, but reasonably-priced tubes are available that will operate at a linear 1 kilowatt output (per tube) without the need for complicated combining networks and extremely high-current regulated DC power supplies. (To run 1 kW output power at 50% stage efficiency using 28 VDC transistors requires a 71.4 amp power supply, the cost of which could exceed that of the rest of the amplifier.) Sure, tube amps usually require tuning, but in the shack, where the operator has access to a wattmeter and tuning controls, this is not a serious drawback.

How efficient can we make a 2 meter tube amplifier? *Very* efficient. We can use a tube circuit that is about 65% efficient running class AB_2, and a power supply that is 90% efficient. Under these conditions, that 400 watt amp would consume a mere 684 VA of AC power, an overall efficiency level of *58.5%* (compare this to the 25% solid-state scenario described earlier). This will generate far less heat, and result in a much lower electric bill for the operator. Can this be practical? Surely.

There are two more neat

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April 29, 30 & May 1, 1994

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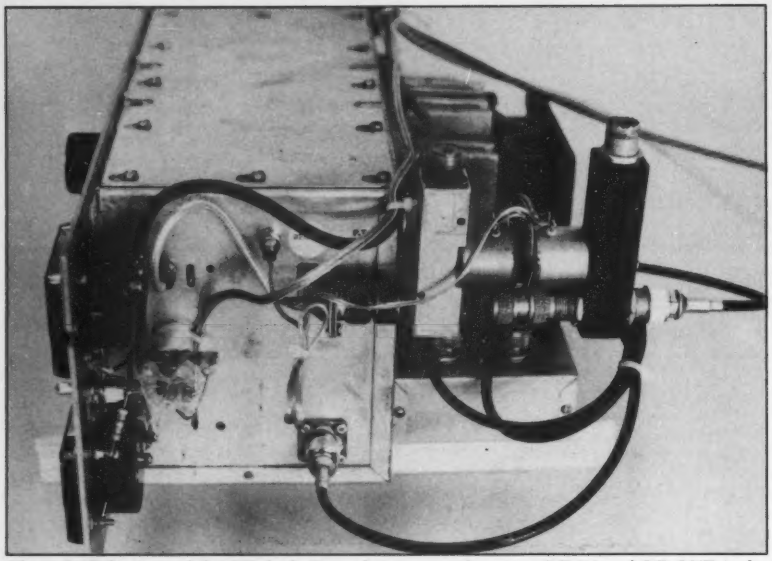

Photo B. Side view of the RF deck. Note the two panel meters, RF IN and RF OUT jacks, meter wiring, and Dow-Key RF relays.

things about tubes. If operated in driven-grid configuration, many power tetrodes will develop about 20 dB gain. Additionally, tubes don't mind heat; in fact, they need it to work. While transistors must be *derated* for operation at high temperatures, and will fail if operated too hot, tubes don't require such derating and most power tubes are intended to be operated at seal temperatures exceeding 200 degrees C, where no normal transistor will survive. Ever see the output power of your solid-state amp start to fall off as it gets hot? This won't happen with tubes.

Finding an Amplifier

We could start "from scratch" and build an amplifier from sheets of aluminum, using a special (and costly) tube socket with spring-finger stock contacts, an air duct chimney, precision-made anode resonators and so forth, but *why*? There are plenty of commercially-made *surplus* RF amplifiers out there which will tune up on 2 meters, available for less than the cost of a single tube. Problem is, most of the surplus comes without documentation, and often without a power supply. Many times a power supply was so big and heavy it was left behind when the amplifier was removed. Sometimes the original power supply was designed to be used on something other than standard 117 VAC power. Still, it is easier to find a high-powered "RF deck" (amplifier without a power supply) than it is a complete unit. So if you find a surplus "RF deck" for a good price, don't hesitate to buy it; the power supply is the easy part and, along with control circuitry, meters, and a relay or two, it can be converted into a great base-station amplifier for little cost or effort.

I stumbled across a beautiful VHF RF deck at the local swap meet. I've seen similar units at the Dayton Hamvention and in the pages of various surplus outlet catalogs. If you want to find a 2 meter RF deck, the key is to look for one that originally covered the 150 MHz band (typically 150-174 MHz) so little or no conversion to the RF circuitry will be required. The deck was unlabeled, but it *looked* like a VHF unit, and a quick check with my trusty Millen 90651 grid-dip meter confirmed that its plate tank circuit resonated at 150 MHz. When I got it home, I checked the tuning range of both the input and output circuits and was pleased to find it tuned right down to 140 MHz without modification.

This deck (see photos) cost me $100, and was worth the price, since it contained an Eimac 8560A conduction-cooled power tetrode that normally retails for about $190; plus, the mating tube socket, beryllium-oxide thermal link, anode heat sink, and all tuning circuitry.

The 8560A is a conduction-cooled version of the famous 4CX250B, and its ratings are identical, but it requires *no* forced-air cooling, blower, air-system socket or chimney. It is rated for literally unlimited anode power dissipation, as long as the anode and base seal temperatures can be maintained below 250 degrees C, and this will be a function of power input, efficiency, and the size of the heat sink used. In the unit pictured, I was able to run 400 watts RF output power for about 20 minutes before the heat sink became uncomfortably warm—that's when I decided to add an outboard "muffin fan" to blow a cooling airstream across the heat sink. If you find a deck with a different tube (e.g., 4X150A; 7034; 4CX250B; 7203; 7580W;

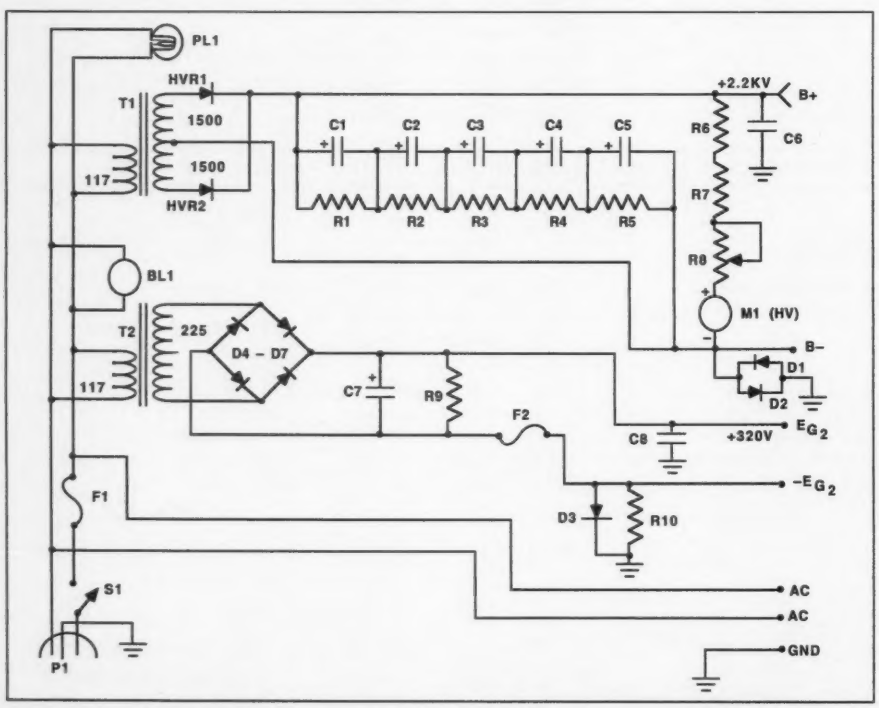

Figure 1. Plate and screen circuit for 2m half kilowatt amp power supply.

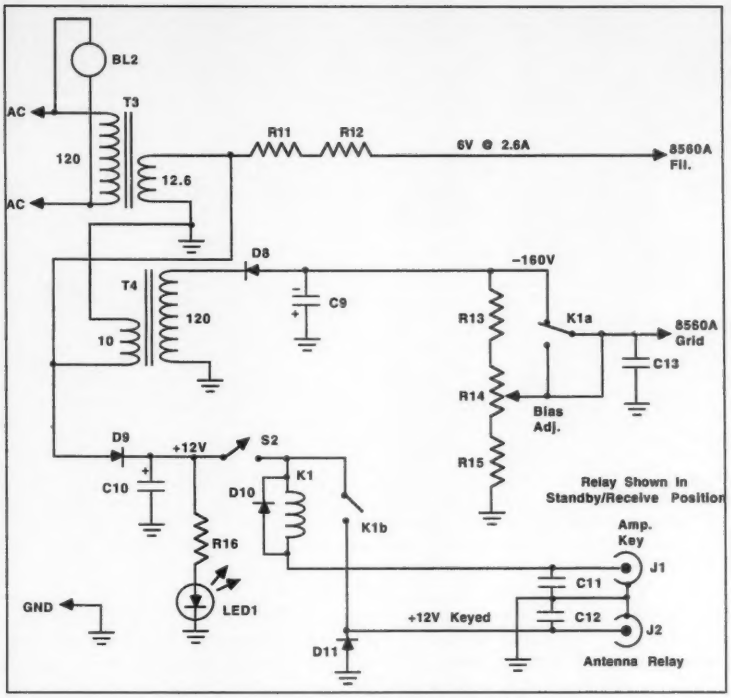

Figure 2. Bias, filament, and control circuit for 2m half kilowatt amp.

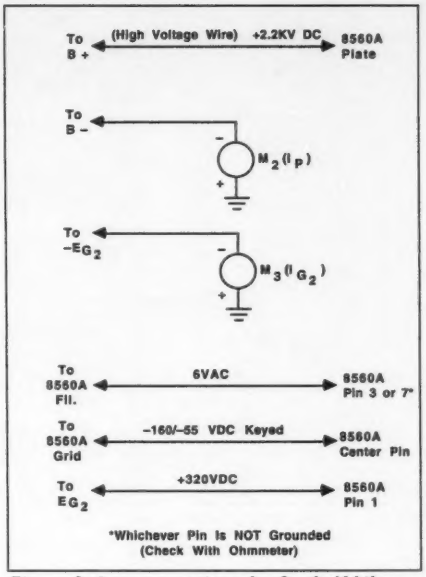

Figure 3. Interconnections for 2m half kilowatt amp.

or 4CX250R) it should still work fine, but if they require air-cooling you'll need to make sure that the original blower, chimney and ductwork are operational.

I decided to make one initial change to the RF circuitry. I noted that the manufacturer used mica chip capacitors to bypass the screen pin of the tube at its socket, but used no further decoupling close to the tube base. This is a huge "no-no" that could result in unstable operation, so I added a 220 ohm, 1 watt *carbon* resistor in series with the screen lead, right at the tube socket, and bypassed the "power supply end" of this resistor with a 0.01 µF, 1 kV ceramic disc capacitor (zero lead length) to ground. This adds considerable RF decoupling for the screen and is recommended for any power tetrode that is not operating grounded-grid. I'd found from many years of experimenting with similar tubes that a carbon resistor works better than an RF choke at this point in the circuit since it offers more wideband decoupling with little fear of resonance and regeneration (instability). It is safe to use a resistor in the screen lead, as it is in the grid bias lead, since the current drawn by these elements is very small.

The Power Supply

The next step was to design and build a modest power supply for the amplifier. The power supply circuit is very simple. The high-voltage (plate) supply is a simple full-wave, center-tap rectifier providing 2200 VDC at 500 mA, filtered by five 250 µF, 450W VDC electrolytic capacitors in series. The total filter capacitance is 50 µF, quite a lot for a 500 mA load. Each capacitor is paralleled by a 50k ohm, 20W wirewound resistor to equalize the voltage across each one. (Please note: Feel free to use something else, if you have it. A single, 20 µF, 2500 to 3000 VDC oil-filled capacitor would serve the purpose here.) The rectifiers are Semtech "Slimpac" type SCH7500, rated 7.5 kV at 500 mA each, found at the local swap meet for $2.50 each. This approach was cheaper and more effective than using big strings of lower-voltage diodes with bridging capacitors and resistors. If you can't find Slimpacs or something similar, "do your own thing" and come up with another solution. In lieu of each Slimpac, four type-1N4007 diodes in series with a 470k ohm, 1/2 watt resistor across each one would work.

To meter the B+ (high voltage), I used a 0-1 mA DC panel meter in series with two 2.4 megohm, 2W resistors and a 250k ohm "calibration" potentiometer, which is used to adjust the meter for accuracy. Because I wanted to meter both high voltage and plate current remotely from the power supply (the meters are on the RF deck), I used a separate "B-" (high voltage return) lead in the power cable between

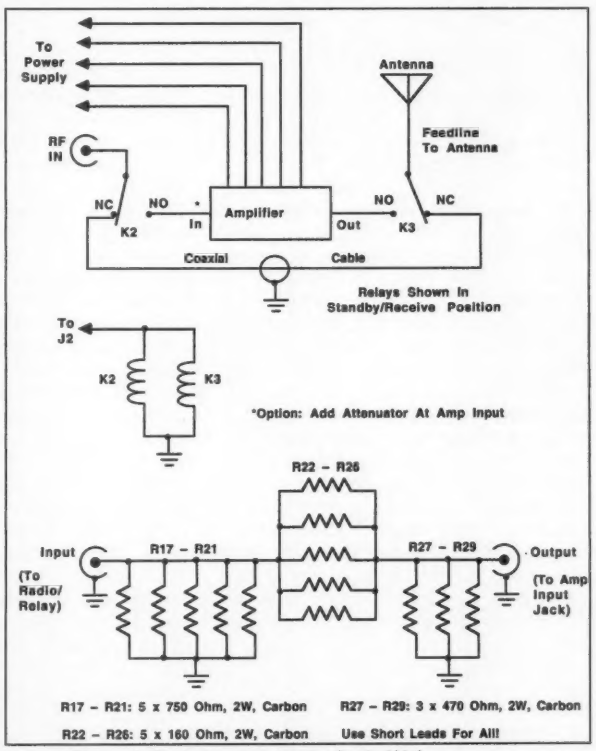

Figure 4. Station connection for 2m half kilowatt amp.

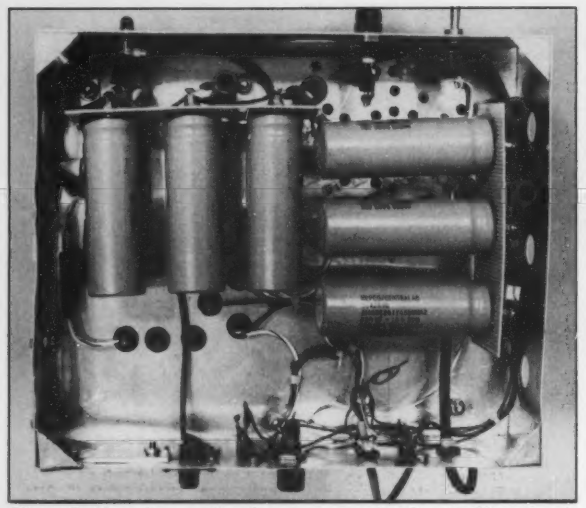

Photo C. View from under the power supply chassis. Note the six high-voltage electrolytics. The bleeder resistors are on the other side of the perf board.

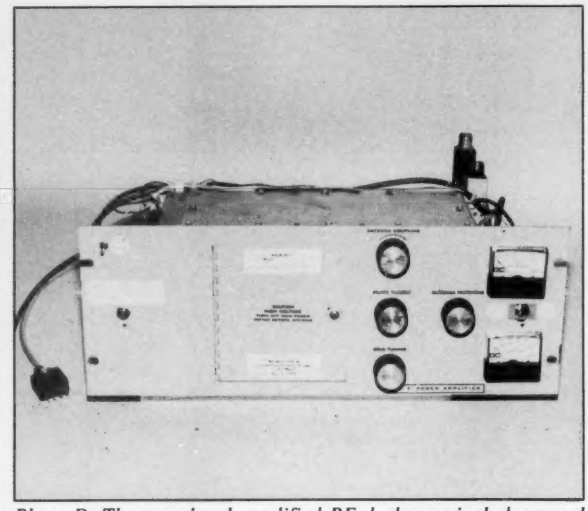

Photo D. The completed, modified RF deck now includes panel meters, a grid bias adjustment pot, and a standby switch.

them, and measured I_P (plate current) in the negative lead—*much* safer than measuring in the "+" lead, which is floating 2200 VDC above ground!

The screen power supply is a full-wave bridge rectifier which develops +320 VDC at about 25 mA. It is not electronically regulated, and many feel that screen supply regulation is key to linearity in tetrode amplifiers. However, it is very stable because the supply is very well filtered by a 250 µF capacitor and a 10k ohm, 20W "bleeder" resistor provides a 32 mA constant load. This load is about 10 times more than the screen current drawn by the tube itself, so the supply voltage doesn't change when the amplifier is run from "key up" to "key down." Electronic regulation with gas tubes or zener diodes wouldn't be much better than this.

For the screen current, negative-lead metering is also used. I used the same 0-1 mA meter that is used for plate current, with a 0.5 ohm, 1 watt precision resistor as a meter shunt. The shunt resistor is located in the power supply, not across the meter itself, to keep the return lead close to ground potential. Possibly the screen current needn't even be monitored, since in operation the amplifier rarely draws any measurable screen current. However, monitoring screen current is useful for tuning the amplifier. You'll also note on the schematic that I used a 1/16 amp, fast-blow fuse in the screen return lead. This will open in the unlikely event the tube tries to draw excessive screen current. (This series of tubes has grid and screen structures which are far more fragile than the cathode or plate, and excessive screen current destroys more power tetrodes than almost any other problem.)

By the time I was finished building the plate and screen power supplies into the little 10" x 12" x 3" chassis, there wasn't much room left for the filament transformer and grid bias power supply. Besides, I wanted to mount a "muffin" fan on the power supply chassis to exhaust the hot air generated by the plate and screen "bleeder" resistors. After all, 35 watts are being dissipated under this power supply chassis, beginning immediately after the "ON" switch is thrown.

No problem: There was sufficient room on and around the RF deck panel to mount the rest of the components necessary for operation. Before mounting sensitive parts like meters and relays, I performed all the drilling and hole-punching. Punching the 1-3/4" holes required for the two meters was a real task because this particular amplifier deck used a solid-steel 1/8"-thick panel. Ugh! Using a "wrench-handle extender" on the socket wrench turning the lead screw to a chassis punch, and after much grunting and groaning, the meter holes were finally completed.

I mounted the filament transformer, bias transformer, relay (to switch bias for the tube and to activate the antenna relays) and other components on the left-hand side of the panel and the rear chassis of the RF deck. Why did I use a 12.6 volt filament transformer for a 6 volt tube filament? Because I *had* one, that's why! And a conventional filament transformer of 6.3 volts would provide excessive voltage for the tube filament, anyway—these tube filaments are rated 6.00 VAC at 2.6 amperes and they do *not* last long with 6.3 volts applied to them. So, a small resistor (or a Variac on the transformer primary) would be required in either case. I used 2.5 ohms total resistance between the 12.6V transformer and the tube filament: one 2.2 ohm, 20W and one 0.3 ohm, 5W wirewound (precision) resistor, both purchased from All Electronics for a total of $2. This results in exactly 6 volts AC at the tube base.

I found a 120V:10V transformer for about a dollar and used it, wired in reverse, to provide grid bias from a half-wave rectifier circuit. The bias rectifier and filter produce -160 VDC (remember, grid bias is *negative*, so the rectifier and capacitor must be wired as shown) which is then adjusted to the proper levels with a three-resistor voltage divider made up of the 3.5k ohm, 10W; 1k ohm, 5W potentiometer; and 1.75k ohm, 5W resistors shown on the schematic. The relay K1 switches the operating bias to the tube from -160 VDC (cutoff, for "standby") to about -55 VDC ("operate") when activated by an outside keying source that simply goes to ground on transmit. Most rigs have such a keying line. The power for the relay coil comes from a small rectifier/filter circuit that is driven by the 12.6 VAC line from the filament transformer. I also used reverse-voltage "spike" suppression (in the form of a diode across the relay coil) to prevent "kickback" voltage from the relay coil from damaging sensitive keying circuits in the radio used to key the amp.

Even if you don't understand its theory, you can make this amplifier *work*! If you follow instructions and schematics exactly, and have someone check your wiring, the thing *has* to work. It's essentially foolproof.

I used another set of contacts on relay K1 to provide +12 VDC for keying the antenna relays, which are a pair of conventional "Dow Key" (Kilovac Corp., Santa Barbara, California) RF relays which bypass the amp on receive ("standby") and place the RF amplifier circuit in the line on transmit. I also added a "standby" switch. This switch breaks the DC line to the relay K1 so that it will not key, even when the exciter is keyed to transmit. Thus, with the switch in "standby," the exciter will run straight through the antenna relays and run "barefoot"; with the switch in "operate," the amp will be keyed into the line. What could be simpler? (The Kilovac Dow Key relays are extremely high-quality devices offering better performance at VHF than the circuit-board-mounted re-

Construction Tips

(1) *Be careful.* There are lots of hazards associated with construction and operation of this equipment, especially when lethal voltages are involved. Even the mechanical work can be hazardous: You'll be using hacksaw blades, drill bits, chassis punches and other sharp tools. Work slowly and carefully, minding the old saw, "Measure twice, cut once," and you'll be more assured that all the cutting will be on the metal and not on your fingers. Use only high-voltage insulated wire for all the plate voltage wiring; the correct wire isn't expensive or rare.

(2) Don't operate high-powered equipment without all shielding covers in place. Load the amplifier only with a shielded dummy load connected by a well-shielded coaxial cable, or an antenna located at least 20 feet from your operating position and other people.

(3) Don't meter the B+! If you want to measure plate current, meter the B- (plate voltage minus return lead) instead. Plastic-faced meters are not rated to withstand 2200 volts and represent a hazard.

(4) Operate only equipment using three-wire AC power cords, with the ground lead firmly connected to the power supply chassis and the plug installed in a three-wire grounded outlet. When wiring the AC line cord in the power supply, make the ground lead (usually green) the *longest* wire, an inch or two longer than the "hot" lines (black and white), so that in the event the line is pulled very hard from the chassis, the ground lead will be the *last* to break or become disconnected.

(5) Cover or protect all exposed potentially hazardous connections, including the 117 VAC line. Use a generous "glop" of RTV sealant and allow it to cure before turning anything on. And even then, be careful.

(6) Some of the resistors in the schematic will dissipate a lot of power, generating considerable heat. Their surfaces get hot enough to burn your skin, even when operating within their ratings. Conceal these so they are out of reach and be careful not to touch them during and immediately after operation.

(7) Use expert soldering techniques. Don't just wrap stranded wire around or through a terminal point and solder—it's bound to have stray "whiskers" which could short against other surfaces. Pre-tin all stranded wires carefully before wrapping and soldering. This is not just safer, it's more attractive. Take pride in construction—it only takes a little effort to do a professional job.

(8) When measuring the output of this amplifier, use only an instrument which can be trusted at this frequency and power level. The Bird Electronics Model 43 Thruline is an appropriate instrument. Many wattmeters are sold that proclaim very wide bandwidth and power ratings (e.g., 1.8 to 144 MHz, 20 to 2000 watts all in one meter), but these are not precise instruments, and they are not only unlikely to measure accurately but they may even burn up.

(9) Use *real* coaxial relays. The best deals are on surplus "Dow Key" type coaxial relays. Use either two SPDT (single-pole, double-throw) coax relays back-to-back as shown, or a single DK260 type DPST coaxial bypass relay, which is specifically made for this application. I've seen the DK60 variety (SPDT Dow-Key with UHF connectors) at swap meets for $15 each surplus. These are great buys! Very little else has ever been manufactured that works as well for so reasonable a price.

(10) Use coaxial cable capable of handling this power at 144 MHz. RG58/U and similar small-diameter cables will *not* cut it, even for very short jumper connections. RG8X ("Mini 8") might work, but you'd be better off using cable that is well within its ratings at 400W and 144 MHz, such as RG213/U, 9913, etc.

(11) Whichever RF deck you start out with, get a copy of the manufacturer's data sheet on the tube and heed its advice. Most of these external-anode tetrodes require 120 seconds warm-up time before applying operate bias and drive. If you inadvertantly key the amp shortly after turning it on, you risk blowing the tube—and as "cheap" as they are, a new one can cost from $65 to $170, depending on which tube you use.

lays in commercial solid-state amplifers. Unlike the little relays used in solid-state amps, these big units have absolutely *no loss* at 144 MHz, and perform very well up to 500 MHz. They are expensive, but can be found surplus for about $15 each.)

You might notice that I didn't meter the grid current. Feel free to do so! But this amplifier is so easy to drive that I added a 3 dB, 50 ohm attenuator ("pad") in series with its input jack. I still turn the RF drive level on my exciter, a Yaesu FT736R, nearly all the way down when I use it, preventing excessive grid current. I have measured the 8560A grid current during bench tests by breaking into the bias circuit with my trusty VOM, and the grid current for proper operation is just about zilch. It kicks to maybe 1 mA on voice peaks on SSB when running the amplifier at 400W PEP output power. Not bad! Since this tube is rated for 2 watts grid dissipation, the grid current could be as high as 18 mA or so in linear service, but drawing this much grid current means something is very wrong. Believe me, there's no reason for any grid current to flow in order to produce a strong and healthy signal.

I used silicone-based RTV sealant on all exposed potentially hazardous connections, the most hazardous of which is probably the 117 VAC line, which has exposed connections at the fans and on the screen transformer.

Results with this $1 per watt amplifier have been gratifying. (Note: The $1 per watt includes the cost of the original RF deck, plus all power supply components, RF relays, meters, fans, power supply chassis, cables and cords, etc., and still leaves room in the budget for buying QSL cards to confirm all the great contacts you will make. The amplifier has a power gain of about 250:1 until it saturates and requires only 2 watts drive for full (400W) output power. To achieve 200W output, less than 1W drive is required. Driving with my ICOM IC2AT "handie-talkie" just for fun (and keying the amp with a clip-lead to activate the relays), the unit produced more than 50 watts output when using the HT in the *low power* position (rated 150 mW output)! Just try to do *that* with transistors!

I used this amp on-the-air in the "VHF Spring Sprints" 2 meter mini-contest the evening of April 9, 1990, and made contact with every single station heard, including many up in the Bay Area, some 400 miles to the north. I used a little F9FT "Tonna" portable yagi, nine elements on a 10' long boom, temporarily installed on a Radio Shack 19" "slip-up" mast. My location for this four-hour exercise was Saddle Peak, a 2800' hill very close to my home.

Tuning this amplifier couldn't be simpler: Apply power to the amplifier and, after waiting two full minutes for the tube to warm up, key the amp with *no* drive power and adjust the "idling" plate current to about 80 mA using the grid bias adjust potentiometer (1k, 5W resistor in the grid bias circuit). Then apply a *small* amount of RF drive and peak all controls on the amplifier for maximum RF output power. Apply slightly more drive and repeak for maximum output. When the RF output reaches about 400 watts after everything is peaked, reduce the drive slightly until the output drops off just a bit, maybe down to 375W or so. No further tuning is required.

When the amp is properly tuned to resonance and maximum output, the I_P (plate current) should be about 300 mA, screen current anywhere from zero to 5 mA, and grid current nearly zero. If you use my pow-

er supply design and are connected to a "stiff" 117 VAC line (normal house wiring should be sufficient), the plate voltage will be 2200 VDC "key up" and 2000 VDC "key down" at full power. Of course, this will depend on exactly what plate transformer you use.

Don't be afraid to experiment! The 4CX250 family of tubes, including the 8560A used here, will perform very nicely with plate voltage anywhere from 1600V to about 2500 VDC. Screen voltage can be from about 275V to 365 VDC, as long as it is stable. The operating bias should be adjustable, as shown, to allow for variations in the other voltages and in the tubes. The amplifier power gain will not be quite as high as I've stated if you use reduced plate and/or screen voltages, but it will still have a *lot* of gain, especially compared with solid-state.

Eimac only rates the tube for a maximum plate voltage of 2000, so using this series of tubes at higher plate voltages is done at the user's risk. However, I've used these tubes for years at 2500 VDC with no ill effects. As stated earlier, filament voltage, screen power and grid power are the critical parameters on these tubes, much more so than plate voltage or even plate power.

Any deck using this series of popular tubes and originally intended for VHF service should work. Try Fair Radio Sales. The military surplus AM-912/GRC is a wonderful unit that Fair has sold for years for about $90 (a great buy!) which tunes 100-225 MHz and uses a single 4X150A. But there's a multitude of commercially-made RF decks out there using these tube types, and many will cover the 2 meter ham band. Since a new tube, socket and chimney for a 4CX250B will cost much more than $100, any amplifier using them and available for about this price is a terrific deal.

A bit of scrounging, and a few hours work building the power supply and control circuitry described here, is all it will take to be a "big signal" on 2. Oh, by the way: I'd stay away from FAA VOR transmitters for use on 2 meters. Since they were designed for frequencies much lower than 144 MHz, my experience has been that most won't tune up to 2 meters, and the conversion to the RF circuitry isn't worth the effort.

Please feel free to write me (21101 Celtic Street, Chatsworth CA 91311; Fax: 818-349-8264) with questions regarding this, or the conversion of other commercial/military gear which will make useful amplifiers for VHF/UHF service. I've converted a lot of them, but many require literally no conversion. Good luck, and good DXing on 2 meters!

Surplus Electronic Outlets Likely to Have RF Decks and Other Required Parts

All Electronics Corp.
14928 Oxnard St.,
Van Nuys CA 91406 (800) 826-5432
(Miscellaneous electronic parts.)

Apex Electronics
8909 San Fernando Rd.
Sun Valley CA 91352
(Miscellaneous electronic parts, especially power transformers, HV capacitors, relays, meters, etc.)

Davilyn Corp.
13406 Saticoy St.,
No. Hollywood CA 91605
(Miscellaneous electronic parts including complete RF decks, power tubes and sockets.)

Fair Radio Sales
1016 E. Eureka, (P.O. Box 1105)
Lima OH 45802 (419) 227-6573
(Miscellaneous electronic parts including complete RF decks, power tubes and sockets, blowers, transformers, capacitors, etc.)

Surplus Sales of Nebraska
1502 Jones St.
Omaha NE 68102 (402) 346-4750
(Miscellaneous electronic parts including complete RF decks, power tubes and sockets, etc.; also Ten-Tec cabinets, Collins parts, etc. to dress up your project!)

Tucker Electronics
1717 Reserve St.
Garland TX 75042
(214) 348-8800, (800) 527-4642
(Sometimes has complete, operational equipment.)

All these dealers publish catalogs or flysheets featuring their current "goodies," and all sell by mail order. Fair Radio has been an excellent source of complete RF decks, with or without power supplies, for a number of years. If you don't see one in their catalog, call them! Also search your local flea markets or swap meets, and contact your local two-way radio shops (found in the Yellow Pages) for possible surplus commercial gear taken out of repeater service.

Parts List

BL1, BL2	Rotron "muffin" fans, 4-1/2" square, 117 VAC	R6, R7	2.4 megohm, 2 watt, 1% or 2% precision high voltage resistors (ceramic or glass insulation)
C1-C5, C7	250 µF, 450V electrolytic	R8	250k ohm, 1 watt potentiometer (HV meter calibration)
C6	0.001 µF, 3 kV ceramic	R9	10k ohm, 20 watt wirewound
C8, C11-C13	0.001 µF, 1 kV ceramic	R10	0.5 ohm 1% or 2%, 1 watt precision
C9	250 µF, 250V electrolytic	R11	2.2 ohm, 20 watt wirewound
C10	1000 µF, 25V electrolytic	R12	0.3 ohm, 5 watt wirewound
D1-D11	1N4007 (1000 PIV, 1A rectifier)	R13	3.5k ohm, 10 watt wirewound
F1	10A 125 VAC "slo-blo" fuse	R14	1k ohm, 5 watt wirewound potentiometer (grid bias adjust)
F2	1/16 125V 3AG fuse (special item)	R15	1750 ohm, 5 watt wirewound
HVR1, HVR2	Semtech SCH7500 or equivalent (7.5k V PIV, 500 mA rectifier assemblies)	R16	680 ohm, 1/2 watt carbon
J1, J2	RCA phono receptacles	R17-R21	750 ohm, 2 watt carbon (only): Do *not* use wirewound.
K1	DPDT relay, 12 VDC coil (non-critical: Radio Shack item or surplus)	R22-R26	160 ohm, 2 watt carbon (only): Do *not* use wirewound.
K2, K3	DK60 Dow-Key SPDT coaxial relays	R27-R29	470 ohm, 2 watt carbon (only): Do *not* use wirewound.
LED1	High-intensity LED, panel mount	S1	SPST, 15 amp rated AC toggle (AC power ON-OFF)
M1	0-1 mA DC panel meter (will read 0-5000 VDC plate voltage when used with R6-R8)	S2	SPST, 3 amp rated mini toggle (STBY-OPERATE)
M2	Plate current meter: Can be 0-500 mA DC used without shunt; or, a 0-50 mA DC meter may be used with a 0.1 ohm shunt resistor; or, a 0-5 mA DC meter may be used with a 0.01 ohm shunt resistor. Use whatever you can find, and select shunt value as appropriate.	T1	Plate transformer. 117 VAC primary: 3000V C.T. (center-tapped) secondary, 1/2 ampere continuous rated (a 750 mA "intermittent duty" transformer is okay).
M3	0-1 mA DC panel meter (will read 00-100 mA DC screen current when used with R10).	T2	Screen transformer. 117 VAC primary: 225V secondary, 100 mA rated.
P1	Three-prong (grounding) 125 VAC plug, 15A	T3	117 VAC primary: 12.6V secondary, 3 amps continuous rated. Could be different secondary voltage (6.3V, 10V, etc.) but if a different rating is used, this will affect the values for R11, R12, R13, R14, R15, etc. Recommend staying with the original rating shown unless you like to experiment.
PL1	125 VAC pilot lamp assembly, panel mount	T4	117 VAC primary: 10V secondary, 1 amp rated (wired in "reverse" as shown on schematic, with the 10V winding used as the primary for this design).
R1-R5	40k ohm, 20 watt wirewound		

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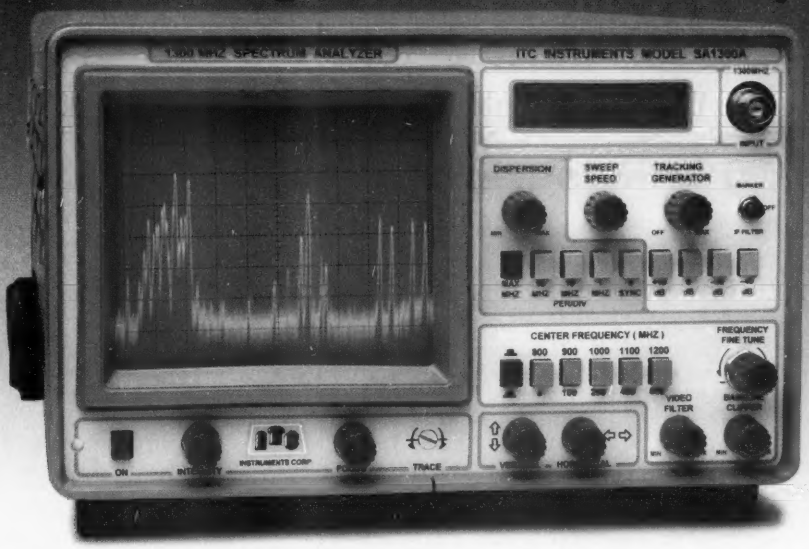

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Using International 9096-IIA

Xtra-flex, low-loss coaxial cable.

by Steve Katz WB2WIK/6

My article called "The Hows and Whys of Coaxial Cable" in the May 1993 issue of *73* created a lot of reader response. Some readers asked about low-loss 50 ohm coax, which is more flexible and easier to use than the popular Belden 9913 but still has the same excellent electrical properties. I've been using Belden 9913 since its first appearance on the market about eight years ago and I've always had very pleasant results, although there are some caveats in the use of this air dielectric cable which I discussed in the May article.

I've searched for years for a suitable substitute for Belden 9913, not because I don't like the Belden product, but simply because it's not flexible enough for some applications. (The original 9913 has a #9 solid center conductor which makes the cable quite rigid.) In contacting the vendors of substitute cables, I found that most were not actual manufacturers, but rather distributors of wire and cable products who were very reluctant to reveal their sources of supply. Often these distributors have their own brand names imprinted on the cables they sell, giving the appearance that they actually have production operations. This is quite common in the wire and cable industry, and many "master distributors" like Alpha Wire Corporation (Elizabeth, New Jersey) have done business for many years and developed excellent reputations. Still, I've been reluctant to recommend distributors as product sources, feeling that if they don't manufacture the product, they have little or no control over it. Sure, we buy ham rigs, computers, TV sets and automobiles from distributors, but we know who made these items and we have the option of contacting the manufacturers directly for technical assistance, problem solving, and so forth, so we feel comfortable about our purchases.

Substitutes for 9913

I've tried products sold by a number of distributors and found some were better than others. I found at least one 9913 substitute, sold by an amateur product distributor who specializes in wire and cable, to be of such poor quality that I literally couldn't strip it. This cable's dielectric was so tightly bonded to its center conductor that it was nearly impossible to remove, but at the same time the dielectric was so poorly bonded to the aluminum-mylar film outer conductor that all attempts to remove the jacket resulted in pulling the dielectric and center conductor right out the end of the cable! This stuff was terrible.

"How does it work? In a word, 'great.' In two words, 'I'm impressed.'"

There's a brand-new product on the market from International Electronic Wire and Cable called 9096-IIA "Extra-Flex." This is another "9913 clone," but it's the best I've seen so far. It is similar to Belden 9913 (described in the sidebar), but instead of having a solid center conductor it has a 19-strand conductor of #9 overall gauge, which makes it very flexible and easy to use. The 9096 bends and flexes as easily as conventional RG8/U or RG213/U, but has far lower loss due to its construction and material content. 9096 has an outside diameter (o.d.) of 0.405" just like mil-standard RG213/U and will accept a standard "UHF" type PL-259 fitting; however, due to its oversized center conductor, it will not fit a standard UG21/U type "N" and must be fitted to a special type N, the kind sold for use with Belden 9913 (how convenient!). I took delivery of 500 feet of 9096 as soon as I heard about it, in part to lab test it but also to potentially use the new product to feed my recently installed 6 and 2 meter beam antennas.

How does it work? In a word, "great." In two words, "I'm impressed." Before installing the cable in my station, I measured its attenuation on the 28, 50, 144, 222, 440 and 1270 MHz bands, where it is most likely to be used in the average ham station. (Its low-loss characteristic would be almost wasted below 28 MHz, as conventional RG213/U is good enough for the majority of installations in the HF spectrum.) This data is shown in Table 1, which compares the loss of 9096 per 100 feet to the loss of conventional mil-standarcd RG213/U (which is the current successor to old-fashioned RG8/U). To make this measurement, I used all 500 feet of 9096 and installed type N connectors on both ends, then divided the measured loss by five to yield "loss per 100 feet." This is more accurate than measuring 100 feet, as it offers five times greater measurement resolution.

9096 will handle the amateur legal power limit throughout the HF-VHF-UHF spectrum, although at very high ambient temper-

Continued on page 51

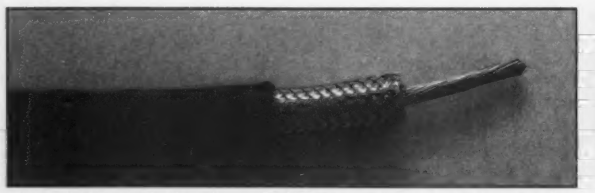

Photo A. The end of a piece of 9096 stripped and ready for installation of a "UHF" PL-259 connector. It strips easily and is a pleasure to work with: One razor blade and five seconds is all it takes to do this.

Photo B. A piece of 9096 with an end stripped and the tinned copper braid pulled back to reveal the aluminum-mylar film shield. You would not normally do this to install connectors. That #9 stranded center conductor is a healthy bunch of copper.

Using International 9096-IIA

Continued from page 48

atures or elevations it may require some derating. It features a type IIA polyvinylchloride (PVC) outer jacket material, which is tolerant to ultraviolet (UV) radiation and therefore requires no protection from the sun, unlike some commercial coaxial cables which can contaminate with UV radiation.

Since cable is a pretty simple product which is most readily assessed for attenuation and ease of use (and most other parameters are not terribly significant), I cannot report a great deal more about the merits of the new International product. It works, it works well, and is a suitable replacement for Belden 9913 for those situations requiring greater mechanical flexibility. Because 9096 is 100% shielded like the semi-rigid "hardline" cables are, it would lend itself well to repeater installations where single-shielded cables don't perform, due to RF leakage and noise generation caused by the braided outer conductor. See the sidebar for more details on construction of International 9096.

Now would be a good time to point out some of the limitations of helical dielectric cables including 9096:

1. This cable is flexible enough to be routed nearly anywhere, but great care must be exercised in its handling due to its internal construction. *Do not*: step on it; use nylon or metal cable ties or clamps to affix it to supports; "kink" it; bend and re-bend it back and forth at the same spot; make any bend of less than 4" internal radius, and if you make such a tight bend, be sure to do it only once in that spot; or place mechanical stress on it at any point where it makes a bend or is affixed to a support. (This is a lot of "do nots" but they are all important, and reasonably easy to follow.)

2. When installing a "UHF" type PL-259 connector, use a lot of heat applied for a brief period of time to get the solder to flow into the connector body holes (for braid connection), rather than a small amount of heat applied for a long period of time. Using a 260 watt soldering gun and soldering all the holes in just a few seconds is much better than using a 100 watt gun and taking 30 seconds to accomplish the task. During and for about five minutes after the connector soldering operation, do not move the cable at or near the soldered connector. Leave it alone so the dielectric can re-form to its intended state and establish a good insulator between the inner and outer conductors of the cable near the connector, or you risk a short-circuit.

3. If you need to affix the cable to a "hard" support such as an antenna boom or mast, tower leg, tower cable standoff arm or whatever, do not use many layers of overlapping vinyl tape pulled tight around the cable and its support—you'll short-circuit the cable at this spot. Instead, use many loosely-wrapped spiral-wound layers of tape, spread over several inches of cable and support. This will be just as strong and place much less stress on the cable.

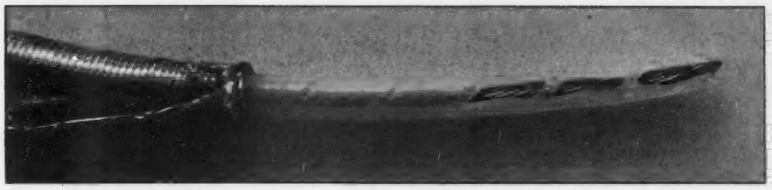

Photo C. A piece of 9096 cut away (sectioned) to reveal its internal construction. If you look closely you can see the spiral turns of polyethylene dielectric, with 1/2" air spaces between them.

4. When "rolling out" the cable for use, *do not* uncoil a bunch of cable and let it lay around on the ground or roof and pull on a free end. This will surely cause destructive "kinks" in the cable. Instead, free up just one coil of cable to connect that free end to your antenna (or whatever), then gently and carefully unroll the cable using a hand-over-hand technique to roll the cable, allowing it to uncoil one turn at a time. If you see a "kink" form, flop the entire roll of cable over in the appropriate direction to "unkink" it, and then continue unrolling. With practice, you won't get any kinks at all. It helps a lot to have the cable wound on a wooden spool, so you can use a piece of 1-1/2" pipe inserted all the way through the spool to create a "handle" on each end. You can hold the pipe ends like handles, and just walk with the spool, allowing it to gently unspool itself. This way, no kinks will form and the whole process is not tiring at all.

"This is a lot of 'do nots' but they are all important, and reasonably easy to follow."

5. When making bends in the 9096, make them as gradually as possible, preferably 9" or greater in radius. I've experimented with this cable to determine it will accommodate a 4" radius bend, just once. If such a small radius bend is "un-bent" and bent again in the same place, it can create an internal short circuit in the cable. When making a "rotor loop" of cable to route around a rotator, make the loop as large as possible, but be sure that it won't snag on guy wires, clamps or other supporting mechanisms as the rotator turns.

If these precautions are followed, the cable will serve you well. Note that all these caveats apply to *any* helical-dielectric cable with air between the turns (9913 included), not just International 9096; the only difference is 9096 is so flexible that it is deceiving—it bends easily, but too much bending can destroy it.

Short Circuits

If you install a long section of 9096 and find that you've created a short circuit in the cable, you may be able to determine where the short is, so the whole length won't require replacement. Surely any point along the cable where it may have kinked and a kink's been "pulled out" during installation would be highly suspect. Also, any point where the cable makes a bend and that point is taped or otherwise affixed to a supporting structure would be suspect, as well.

If you inspect the line and can find no visible clue as to why the cable shorted, try using a high-quality directional wattmeter in the shack and transmitting into the cable on the highest frequency you can generate. Record both forward and reflected power readings. If they are both equal, the short circuit is very close to your transmitter. If the reflected power is considerably lower than forward, the short is farther away. If the short were all the way up at the antenna end, then the reflected power reading would

Continued on page 54

Frequency	Attenuation in dB/100 feet	
	9096	RG213/U
28 MHz	0.65 dB	1.20 dB
50 MHz	0.82 dB	1.62 dB
144 MHz	1.35 dB	2.40 dB
222 MHz	1.76 dB	3.78 dB
440 MHz	2.60 dB	5.71 dB
1270 MHz	5.13 dB	10.87 dB

Notes: Data from measurements taken by WB2WIK 7/93 on 500-ft. lengths of each cable type shown. No data taken for 903 MHz as transmitter was unavailable. Extrapolation indicates that at 903 MHz, 9096's loss would be approximately 4.0 dB, and RG213/U's would be 8.7 dB. 9096 may not support use above 2 GHz due to minor inconsistencies in center conductor spacing resulting from the use of soft materials. I recommend only "sweep-tested" cables above 2 GHz.

Table 1. Attenuation per 100 feet vs. operating frequency, International 9096 and MIL-STD RG213/U.

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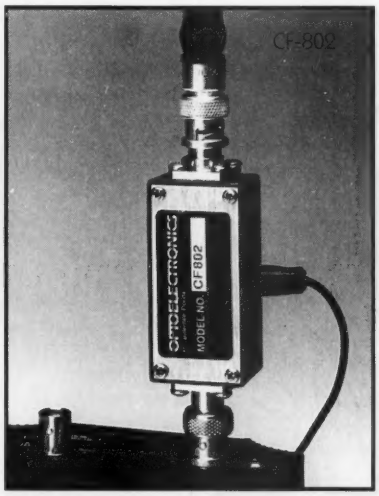

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OPTOELECTRONICS

CIRCLE 172 ON READER SERVICE CARD

Using International 9096-IIA

Continued from page 51

be equal to forward power generated, minus two times the loss of the cable.

Say you're using 100 watts of power at 144 MHz, and 100 feet of 9096 cable. You know you have a short somewhere, but don't know where. You transmit into the cable and measure 100 watts forward power and 70 watts reflected power. You refer to Table 1 of this article to determine that 9096's loss per 100 feet at 2 meters is 1.35 dB. This means its "round-trip" loss for a signal generated by your transmitter, reflected back from the far end of the cable and back down to your wattmeter, is 2.7 dB. Thus, if the short-circuit were right at your antenna, 100 feet "down the line," you'd measure 2.7 dB less reflected power than forward power. 100 watts minus 2.7 dB is 53.7 watts. So, if your short circuit were at the antenna, you should measure 53.7 reflected power. But you didn't; you measured 70 watts, which means the short circuit is closer to your transmitter than 100 feet. 70 watts is 1.55 dB less than 100 watts, so the short circuit is "1.55 dB away." 1.55 dB divided by two is 0.775 dB. 0.775 divided by 1.35 dB (the loss for 100 feet of cable) is 0.574. This would place the short-circuit at about 57.4 feet from your transmitter.

This method of establishing where a short circuit in coaxial cable is located is a bit crude, as it relies heavily on the accuracy of your directional wattmeter, published data regarding line losses, and so forth. But it's better than nothing, and is probably about 90% accurate. Thus, if you were to cut your cable about three feet before and after the 57.4-foot point (that is, cut it at 54 feet and 61 feet from the transmitter end) and check the section of cable you've cut out of the line, there is a fair assurance that the short circuit would be located in that section. Not foolproof, but, again, better than no system at all. A more accurate assessment could be made using a time-domain reflectometer (TDR), but not many

What makes 9096 different from ordinary RG213/U (the successor to old-fashioned RG8/U) coaxial cable?

Instead of using a solid polyethylene dielectric and a #13 gauge center conductor as in RG213/U, 9096 uses instead a dielectric which is mostly air and a center conductor of #9 gauge. To hold the center conductor in place, securely centered between the cylindrical "sides" of the outer conductor, RG213/U uses solid polyethylene, a good dielectric material; 9096 uses instead a thin spiral of polyethylene with large air spaces between the turns of the spiral. This is called a "helical" dielectric, because its construction resembles a helix. The helix turns occur at 1/2" spacing in 9096, which is about as far apart as they can be without risking a short circuit at every bend in the cable. The closer together the helix turns are, the more mechanically robust the cable will be, but closer spacing will increase the cable's dielectric constant, slow down its velocity of propagation factor, and increase the cable's transmission losses. The farther apart the turns are, the more mechanically fragile the cable will be, but farther spacing will reduce the cable's dielectric constant, speed up its velocity of propagation, and decrease the cable's transmission losses. This is a trade-off, and International made an intelligent choice by using 1/2" spacing. It's a good compromise between attenuation and usability.

Because the dielectric constant is so much lower with this construction, 9096 can use a much larger center conductor diameter without decreasing the cables nominal impedance. 9096 is a 50 ohm impedance cable that uses a huge center conductor (19 strands of #21 copper wire) to decrease ohmic and "skin effect" losses and reduce attenuation. Popular "9913" cable, introduced by Belden in the mid-1980s and copied by many, is very similar in construction but uses a solid #9 center conductor, making it more difficult to flex. International calls its 9096 "Extra-Flex" and they're not kidding—it is very flexible indeed.

Another difference between 9096 and normal military cable types like RG213/U is the construction of the outer conductor. RG213/U uses braided copper, tightly woven to provide 95% to 97% coverage of the dielectric. This is good, low-loss material that has sufficient shielding for most applications, but it is not "100% shielded." Even RG214/U, which uses two silver-plated copper woven braids, is not "100% shielded," although it is about 99%. International 9096 uses two outer conductors and provides truly "100% shielding." The innermost of the conductors is an aluminum-mylar film which completely covers the dielectric and provides 100% shielding. However, it would be impossible to solder or clamp to this shield, as it is thin and fragile like household aluminum foil and aluminum is not readily soldered with standard materials. So, over the aluminum-mylar film is a tinned copper braid which offers about 95% coverage. This tinned copper braid is very strong and can be readily soldered to a PL-259 or clamped in a type N connector, just as one would do for the mil-standard cables.

"In essence, I'm giving up 1.8 dB on 2 meters at a cost savings of more than $400!"

So, although the outer diameter of 9096 is 0.405" just like RG213/U, its use of a largely air dielectric and an oversized center conductor allows it to have substantially less attenuation. Whether you'll notice the lower loss depends on what frequency you operate and how much cable you use. I would not recommend it for runs of less than 100 feet on frequencies below 28 MHz, as the difference in loss will be impossible to detect. But if you use 100 feet or more at frequencies of 144 MHz or higher, you *will* notice an improvement in station performance. If you refer to Table 1, you'll see that 9096 has less loss per 100 feet length (as compared with RG213/U) by about 1 dB on 2 meters, about 2 dB on 222 MHz, 3 dB on 440 MHz, etc. As you can see, the higher the frequency used, the more notable the improvement will be if you use 9096 instead of solid-dielectric cables.

The difference will also be more notable when long transmission lines must be used. For example, in my station, I need 250 feet of coax to feed my 2 meter beam, and another 250 feet to feed my 6 meter beam, since they are both located on a tower that is 200 feet behind my home. By using 9096 instead of RG213/U, I've saved about 2.5 dB in feedline loss on 2 meters—definitely a worthwhile improvement. I could save another 1.8 dB or so if I changed from 9096 to 7/8" "hardline" (solid-conductor, rigid cable), but at *very* significant expense. The 9096 costs about as much as good-quality RG213/U, but 7/8" "hardline" retails for about $2 per foot, plus its connectors can cost another $40 each or so. In essence, I'm giving up 1.8 dB on 2 meters at a cost savings of more than $400! But my first 2.5 dB station improvement came from using 9096, at an added cost of literally nothing! Each of us has our own sense of values, but for the $400+ I'm saving by not using 7/8" coax, I could take my family on a short vacation.

The only trade-off in using 9096 instead of RG213/U is that the International product—like all helical-dielectric "soft" cables—is more fragile, and more care must be used in handling and installation. If you choose to use it, and I recommend you do if it will improve your station performance at no added cost to you, just be *careful*. If you handle the cable as though it were a crate of fresh eggs it will serve you well.

hams have access to this piece of laboratory equipment.

I offer advice on all this because it is possible that many users of 9096 and similarly constructed cables will create a short circuit during installation, especially if the cable isn't handled with care. With experience and repeated use, you'll find 9096 is great stuff and short circuits will be avoided.

International 9096 is available from many wire and cable retailers. Look for those distributors who specifically advertise "9096-IIA Extra-Flex" rather than just "flexible 9913 type" cables, to be sure you're getting the product described here. It retails for about the same price as Belden 9913 or standard RG213/U (in the 69¢ per foot range for 100-foot lengths), making it a very attractive deal for those wishing to use flexible but low-loss coax. When you order, be sure to request a copy of International's 10-year warranty. Distributors should have no difficulty providing you with a copy of this document.

More About 9096

International Electronic Wire & Cable offers their 9096 and other products for sale through franchised distributors. For technical information, they may be contacted directly at 89-1/2 O'Leary Drive, Bensenville IL 60106. Their 10-year warranty on 9096-IIA states, ". . . cable is warranted against defects in material or workmanship for 10 years from date of purchase. Any defective footage will be replaced free of charge when shipped pre-paid with proof of purchase to (their address). This warranty does not apply to damage resulting from accident or misuse. Liability is limited to replacement only and does not include installation."

9096-IIA is rated by the manufacturer as follows:

Dielectric strength	3000 VDC (equivalent to 2121 Vrms AC, which would be 89,973 watts!)
Capacitance	24 pF/foot
Impedance	50 ohms
Velocity factor	84% (important to know in the design of phasing lines or transformers)
DC resistance	0.95 ohms/1000 feet
Attenuation	0.9 dB/100 feet at 50 MHz
	1.4 dB/100 feet at 100 MHz
	1.8 dB/100 feet at 200 MHz
	2.6 dB/100 feet at 400 MHz
	4.2 dB/100 feet at 900 MHz
	4.5 dB/100 feet at 1000 MHz

(Note: Attenuation ratings differ from actual test data taken by this author as shown in Table I, but not by very much. I measured the cable to be better than its ratings on all frequencies below 1000 MHz.)

UPDATES

Number 14 on your Feedback card

ASCII-to-Morse-Code Interface

If you wish to order the kit from Suncoast Technologies for the above-mentioned project (February 1994, page 36), the correct telephone number to call is (904) 596-7599.

Using the World's Most Accurate Frequency Standard

The above-mentioned project is a three-part series which appeared in the January, February, and March 1994 issues. There is a slight error on the PC board layout for Part 1, the WWVB Receiver, which appeared in February, page 23, Figure 5. Shown below is the correct foil pattern and a simple cut-and-jumper fix for the one we printed. The RF amp will still work without this fix; it just won't work very well.

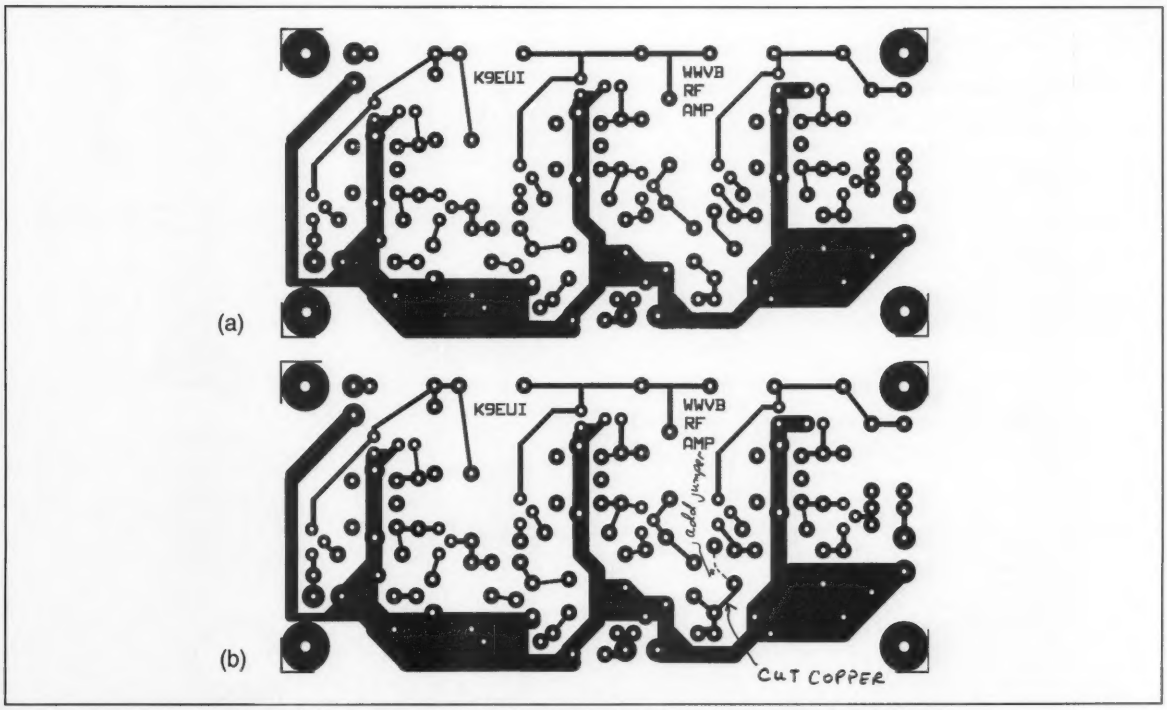

Figure 1.a) New artwork for the WWVB Receiver. b) A simple cut-and-jumper fix for the original artwork.

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Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 4.5dBi ⅝ wave 446MHz 7.2dBi ⅝ wave x 3	1.5:1 or less	150 watts	4' 11"	Gold Plated PL-259

FL-62S Dual-Band 146/446MHz w/Fold-Over, No Ground Plane Required

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 3.5dBi ½ wave 446MHz 6.0dBi ⅝ wave x 2	1.5:1 or less	150 watts	3' 5"	Gold Plated PL-259

NEW!

SB-7/SB-7NMO Dual-Band 146/446MHz w/Fold-Over, No Ground Plane Required

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 4.5dBi ⅝ wave center-loaded 446MHz 7.2dBi ⅝ wave x 3	1.5:1 or less	70W FM	4' 7"	PL-259 or NMO style

NEW!

SB-5/SB-5NMO Dual-Band 146/446MHz w/Fold-Over, No Ground Plane Required

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 3.0dBi ½ wave 446MHz 5.5dBi ⅝ wave x 2	1.5:1 or less	120W FM	38"	PL-259 or NMO style

NEW!

SB-2/SB-2NMO Dual-Band 146/446MHz

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 2.15dBi ¼ wave 446MHz 3.8dBi ⅝ wave	1.5:1 or less	60W FM	18"	PL-259 or NMO style

NEW!

B-10/B-10NMO Dual-Band 146/446MHz, Cellular Look-a-like

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 0dBi ¼ wave 446MHz 2.15dBi ½ wave	1.5:1 or less	50W FM	12"	PL-259 or NMO style

B-20/B-20NMO Dual-Band 146/446MHz, Cellular Appearance, No Ground Plane Required

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 2.15dBi ½ wave 446MHz 5.0dBi ⅝ wave x2	1.5:1 or less	50 watts	30"	PL-259 or NMO style

NEW!

SB-25/SB-25NMO Mono-Band 146MHz w/Fold-Over, No Ground Plane Required

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 4.1dBi ⅝ wave center loaded	1.5:1 or less	100W FM	4' 9"	PL-259 or NMO style

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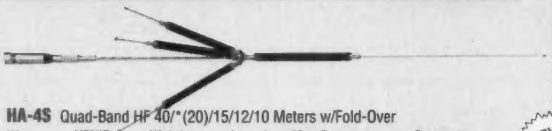
CX-224 Tri-Band 146/220/446MHz, w/Fold-Over, No Ground Plane Required

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 2.15dBi ½ wave 220MHz 3.6dBi ⅝ wave 446MHz 6.0dBi ⅝ wave x 2	1.5:1 or less	100 watts	3'	PL-259 or NMO style

FJ-15S Tri-Band 52/146/446MHz w/Fold-Over

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
52MHz 2.15dBi ¼ wave 146MHz 4.5dBi ⅝ wave 446MHz 7.2dBi ⅝ wave x 3	1.5:1 or less	120 W FM	4' 10"	PL-259

HF MOBILE AND HT ANTENNAS



HA-4S Quad-Band HF 40/*(20)/15/12/10 Meters w/Fold-Over

NEW!

Wave:	VSWR:	Weight:	Length:	Max Power:	Connector:
¼ wave	2:1 or less	1 lb. 14 oz.	4' 4"	120W SSB (200W SSB 28MHz)	PL-259

*L-14HS Optional 20 Meter Coil

SH-55 Super Flexible 146/446MHz HT Antenna

Gain & Wave:	Max Power:	Length:	Connector:
146MHz 1.5dBi ¼ wave 446MHz 3.2dBi ⅝ wave x 2	10 watts	15.5"	BNC

NEW!

CH-722SA High Gain HT Antenna
Gain & Wave: 146MHz 3.0dBi ½ wave
446MHz 5.5dBi ⅝ wave x 2
Max Power: 50 watts
Length: 35", 2 sections, 18" each
Connector: BNC

CH-32 Miracle Baby 146/446MHz HT Antenna
Gain & Wave: 0dB ¼ wave
Max Power: 10 watts
Length: 1.75"
Connector: BNC

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Band Pass, Ins Loss, Max Pwr.
1.3-150MHz, 0.1dB, 800w PEP
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Isolation: 60dB
CONNECTORS:

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Output:	SO-239	SO-239	SO-239
Low In:	PL-259	PL-259	SO-239
High In:	PL-259	N-Male	SO-239

RS-21
Trunk, hatchback, rear door (van, blazer, etc.) mount. Adjustable to virtually ANY angle. Rubber-coated base protects vehicle paint.

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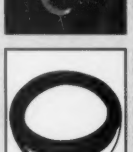
RS-820
Heavy-Duty, Low Profile Trunk Lip or Hatch Back Mount. Rubber-coated base protects vehicle paint.

WS-1M
Multi-Adjustable Window Clip Mount.
11.5 feet of high quality coax. Gold-plated UHF Conns. for Antennas up to 40" in height.

NEW!

3D4M Standard Cable Assembly
13.5 feet of low loss coax. Gold plated UHF (PL-259/SO-239) connectors.
3D5M Standard Cable Assembly
Same as 3D4M, but 17 feet of coax



CK-5M Deluxe Cable Assembly
13 feet double shielded very low loss coax + 12" RG-188 teflon coax. Gold plated UHF (PL-259/SO-239) connectors.
CK-5M5 Deluxe Cable Assembly
Same as CK-5M, but 17 feet of coax

NEW!

MINI SPEAKER/MIC

HM-P2K/F
Mini spkr/mic featuring full TX/RX quality!
Light weight, extremely small: 1"x2" with collar pocket clip.
HM-P2K: Kenwood Version
HM-P2F: Icom/Yaesu Standard/Alinco/etc.

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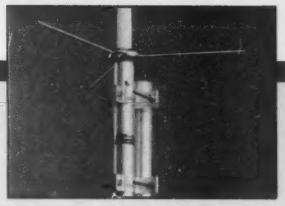

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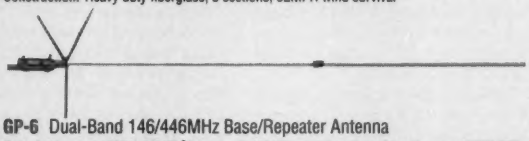
COMET DUAL-BAND

NEW!

GP-9(N) Dual-Band 146/446MHz Base/Repeater Antenna

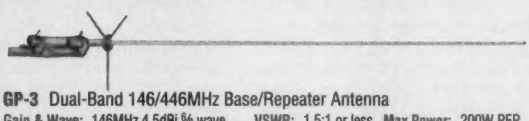
Gain & Wave: 146MHz 8.5dBi ⅝ wave x 3 446MHz 11.9dBi ⅝ wave x 8 **VSWR:** 1.5:1 or less **Length:** 17' 8" **Max Power:** 200W PEP **Weight:** 5lbs. 11ozs.
Connector: SO-239 (GP-9), N-type (GP-9N) **Mounts to Mast Size:** 1.25"-2.50"
Construction: Heavy duty fiberglass, 3 sections, 92MPH wind survival



NEW!

GP-6 Dual-Band 146/446MHz Base/Repeater Antenna

Gain & Wave: 146MHz 6.5dBi ⅝ wave x 2 446MHz 9.0dBi ⅝ wave x 5 **VSWR:** 1.5:1 or less **Length:** 10' 2" **Max Power:** 200W PEP **Weight:** 3lbs. 8oz.
Connector: Gold-Plated SO-239 **Mounts to Mast Size:** 1.25"-2.50"
Construction: Heavy duty fiberglass, 2 sections, 112MPH wind survival



NEW!

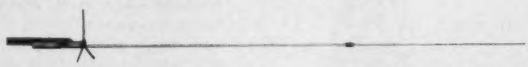
GP-3 Dual-Band 146/446MHz Base/Repeater Antenna

Gain & Wave: 146MHz 4.5dBi ⅝ wave 446MHz 7.2dBi ⅝ wave x 3 **VSWR:** 1.5:1 or less **Length:** 5' 10" **Max Power:** 200W PEP **Weight:** 2lbs. 9ozs.
Connector: Gold-Plated SO-239 **Mounts to Mast Size:** 1.25"-2.50"
Construction: Singe piece fiberglass, 130MPH wind survival

COMET MONO-BAND

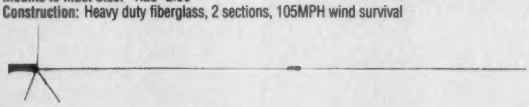
CA-ABC23 Mono-Band 146MHz Base/Repeater Antenna

Gain & Wave: 146MHz 7.8dBi ⅝ wave x 3 **VSWR:** 1.5:1 or less **Max Power:** 200W PEP
Connector: SO-239 **Length:** 14' 12" **Weight:** 3lbs. 8 ozs.
Mounts to Mast Size: 1.25"-2.50"
Construction: Thick-wall aluminum, 3 sections, 70MPH wind survival



CA-712EF Mono-Band 446MHz Base/Repeater Antenna

Gain & Wave: 446MHz 9dBi ½ wave x 12 **VSWR:** 1.5:1 or less **Max Power:** 200W PEP
Connector: N-type **Length:** 10' 5" **Weight:** 2lbs. 12ozs.
Mounts to Mast Size: 1.25"-2.50"
Construction: Heavy duty fiberglass, 2 sections, 105MPH wind survival



CA-62DB Mono-Band 6 Meter FM Antenna

Gain & Wave: 52MHz 6.5dBi ⅝ wave x 2 **VSWR:** 1.5:1 or less **Max Power:** 500W PEP
Connector: SO-239 **Length:** 21' 8" **Weight:** 5lbs. 11ozs.
Mounts toMast Size: 1.25"-2.50"
Construction: Thick-wall aluminum, 5 sections, 100MPH wind survival

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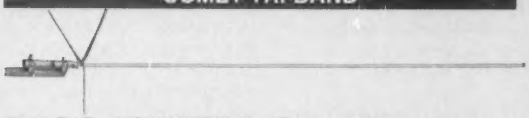
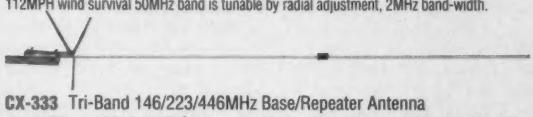
COMET TRI-BAND



NEW!

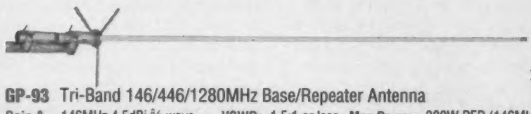
GP-15 Tri-Band 52/146/446MHz Base/Repeater Antenna

Wave: 50-54MHz ⅝ wave 146MHz ⅝ wave x 2 446MHz ⅝ wave x 4 **VSWR:** 1.5:1 or less **Length:** 7' 11" **Max Power:** 300W PEP **Weight:** 3 lbs. 1 oz.
Mounts to Mast Size: 1.25"-2.50"
Connector: Gold-Plated SO-239 **Construction:** Single piece heavy-duty fiberglass, 112MPH wind survival 50MHz band is tunable by radial adjustment, 2MHz band-width.



CX-333 Tri-Band 146/223/446MHz Base/Repeater Antenna

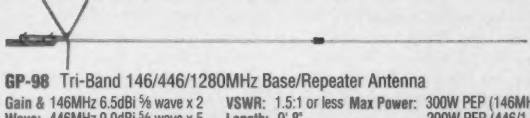
Gain & Wave: 146MHz 6.5dBi ⅝ wave x 2 223MHz 7.8dBi ⅝ wave x 3 446MHz 9.0dBi ⅝ wave x 5 **VSWR:** 1.5:1 or less **Length:** 10' 2" **Max Power:** 120W PEP **Weight:** 3 lbs. 10 ozs.
Mounts to Mast Size: 1.25"-2.50"
Connector: Gold-Plated SO-239
Construction: Heavy duty fiberglass, 2 sections, 112MPH wind survival



NEW!

GP-93 Tri-Band 146/446/1280MHz Base/Repeater Antenna

Gain & Wave: 146MHz 4.5dBi ⅝ wave 446MHz 7.2dBi ⅝ wave x 3 1280MHz 10dBi ⅝ wave x 6 **VSWR:** 1.5:1 or less **Length:** 5' 7" **Mounts to Mast Size:** 1.25"-2.50" **Max Power:** 300W PEP (146MHz) 200W PEP (446/1.2) **Weight:** 2 lbs. 8ozs.
Connector: Gold-Plated N-type
Construction: Single piece heavy duty fiberglass,112MPH wind survival



NEW!

GP-98 Tri-Band 146/446/1280MHz Base/Repeater Antenna

Gain & Wave: 146MHz 6.5dBi ⅝ wave x 2 446MHz 9.0dBi ⅝ wave x 5 1280MHz 13.5dBi ⅝ wave x 12 **VSWR:** 1.5:1 or less **Length:** 9' 8" **Mounts to Mast Size:** 1.25"-2.50" **Max Power:** 300W PEP (146MHz) 200W PEP (446/1.2) **Weight:** 3 lbs. 8ozs.
Connector: Gold-Plated N-type
Construction: Single piece heavy duty fiberglass,2 sections, 112MPH wind survival

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- Cross Needle Meter provides FWD, REF, and VSWR simultaneously.
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CMX-1	CMX-2	CMX-3
1.8-60MHz	1.8-200MHz	140-525MHZ
0-2KW	0-200W	0-200W
30/300/2KW	20/50/200W	20/50/200W

NEW!

Number 15 on your Feedback card

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

The Shuttle Amateur Radio EXperiment (SAREX) has been flying into space for over a decade. Since Owen Garriott W5LFL went up on STS-9 in November 1983 with a Motorola handie-talkie, small tape recorder and a curious in-the-window antenna, many missions have followed with amateur radio on board.

There have been missions with slow-scan television (SSTV), fast-scan television (FSTV), packet and voice. Figure 1 shows the four different configurations currently supported. Changes to the equipment list occur on a regular basis as new headsets, tape recorders, antennas and connectors are developed.

SAREX has several objectives. The primary one is to encourage children to pursue careers in science and mathematics and to show that there is a connection between education and real-life activities. Another goal is to promote public interest in space activities and amateur radio. SAREX also provides a means to conduct scientific experiments with amateur radio, to promote international goodwill, and to provide a meaningful recreational activity for shuttle crew members.

It takes more than just a radio and an antenna to fly a SAREX mission. Even the voice-only mode includes 12 items. When running "the works" the system has more gear than most amateur-radio home stations. One astronaut on STS-56 (configuration D) said the SAREX set-up was like "a dark closet full of black spaghetti." Another comment referred to the operation as a Field Day station in the dark. A close look at all the equipment in configuration D reveals a very complex setup. Imagine the gear either floating around or velcro'd to available flat surfaces. Then turn the lights down and try operating!

Hundreds of hams, other volunteers and NASA individuals who recognize the importance of SAREX keep the program running. Some are involved with school selection, contact scheduling, telephone bridge coordination when needed, hardware testing, maintenance and logistics, astronaut training and licensing. The astronauts who pursue their licenses and operate the equipment from space invariably become enthusiastic supporters. Bill McArthur KC5ACR was asked if he had any suggestions for future SAREX crews after he came back from STS-58 in November 1993. Bill thought for a moment and commented that his only suggestion was that SAREX should be flown on all missions.

Although personal contacts and general ham QSOs are fun, school contacts really keep the crew members' interest and bring more astronauts into ham radio. For the kids, there is something special about talking directly to an astronaut orbiting the Earth. For the astronauts, it's the satisfaction of bringing the adventure of space exploration directly into the classroom and perhaps inspiring students to pursue interests in science and engineering.

During STS-58, 17 scheduled school contacts were made. One was with a school in France. In addition, the audio was distributed via ham radio to more than 10,000 French students in other schools, so they could listen in on the contact too. For many amateur radio operators, listening to the shuttle downlink during a school pass is better than listening to random contacts with other hams. But for all hams, the real thrill is to make a personal voice or packet contact direct with SAREX.

Recent missions have been great for random ham contacts. In 1993, the SAREX working group drafted a new set of SAREX contact guidelines to better define school contact activity and general ham QSOs. A list of proposed schools must be provided to NASA seven months prior to launch. This means that applications from schools to the American Radio Relay League (ARRL) must be submitted and accepted even earlier. The total number of SAREX school and experimental activities, excluding personal flight crew scheduled contacts, are not to exceed two per day for the duration of the mission. Personal contacts are typically limited to one per crew member and are usually accomplished through telephone bridges made outside the mainland U.S.

SAREX organizers have recognized that contacts with the general ham population are essential. The flight crew is encouraged to make voice or packet contacts with hams whenever possible. During STS-58, KC5ACR, KC5AXA and KC5CKM made many voice contacts and logged hundreds of packet connects and full QSOs using the W5RRR-1 packet robot. When SAREX is left unattended during a flight, the packet system is activated in robot mode as much as possible. During STS-60 in early February, the robot system was very busy due to the focus of crew efforts on difficulties with the Wake Shield Facility experiment. While many would have preferred to hear more voice operation, others recalled earlier missions that had no ham activity at all on many passes. The ham-astronauts for STS-60 included Commander Charlie Bolden KE4IQB, Mission Specialist Ron Sega KC5ETH and Cosmonaut Sergei Krikalev U5MIR, also known as UZ3AK.

How to Work SAREX

The July 1993 "Hamsats" column covered the procedures necessary to successfully make a contact with the ham station on the shuttle. It's very competitive and usually more difficult than amateur satellite operation. The column described methods for tracking the shuttle, operating with voice or packet and getting a QSL. A brief summary of the process includes knowing when to listen, what frequencies to use for packet and voice, and what to expect.

Preliminary orbital element sets for use with computers are always posted to packet and telephone bulletin board systems (BBSs). While they provide an idea of what type of orbit the shuttle will have for a particular mission, they are rarely accurate, due to launch rescheduling. Shortly after launch the data is updated and is again distributed. During the mission this information can also be obtained from ARRL bulletins at 9:45 p.m. and 12:45 a.m. EST on 3.99, 7.29, 14.29, 18.16, 21.39 and 28.59 MHz. The Goddard Amateur Radio Club in Greenbelt, Maryland, carries news and shuttle retransmissions on 3.86, 7.185, 14.295, 21.395 and 28.65 MHz. The Johnson Space Center Amateur Radio Club in Houston, Texas, also carries news and retransmissions on 3.85, 7.227, 14.280, 21.350 and 28.40 MHz.

For those without tracking software, tabular listings are posted via packet and phone BBSs with antenna headings and access times for many major cities in North America and the world. Two phone BBSs that carry the information are the NASA Spacelink computer at (205) 895-0028 and the ARRL BBS at (203) 666-0578.

The common downlink for all general or random ham activity is 145.55 MHz FM. This is for both packet and voice. If nothing is heard during a pass, then the SAREX equipment is either off or being used for a personal or school contact on another, usually nearby, frequency. If the monitored signals are not on 145.55 MHz, do not attempt a contact—it will only interfere with a scheduled activity that uses a non-standard uplink.

The packet system uplink is 144.49 MHz. The SAREX gear is not set up for simplex. All activity is split-frequency. For voice over North America, there are five possible uplinks, including 144.91, .93, .95, .97 and .99 MHz. The ham-astronaut will typically listen wherever he or she can get the best contact and will tune to another channel if congestion is high or no signals are heard. There are three European uplinks on 144.70, .75 and .80 MHz. These are not used over North America for general contacts.

During voice contacts, transmissions will be short and usually only include the exchange of calls and names. Many stations are usually listening and trying to get in, so brevity is vital.

On packet the callsign of the "robot" is W5RRR-1. Figure 2 shows a sample of packet activity monitored during STS-

Photo A. STS-57 Pilot Brian Duffy N5WQW operating SAREX in late June 1993 on board the shuttle Endeavour. *(NASA photo.)*

Photo B. STS-58 Mission Specialist Bill McArthur KC5ACR made many voice contacts on 2 meters using the SAREX gear on the space shuttle Columbia *in late October 1993. (NASA photo.)*

60. When a connect request is received by the robot, a QSO number is sent. If the number is acknowledged, the robot will send a disconnect to the ground station and the contact is complete and logged in the SAREX terminal node controller (TNC). Since many stations are simultaneously trying for a contact, the odds are high that a complete sequence of transmissions between the robot and ground station will not occur. It should only take between 10 and 30 seconds from the time the connection is established 'til the "disconnected" message appears. If more than a minute has passed, manually disconnect and try again. Complete contacts are shown in a "QSL" list broadcast by the TNC, and incomplete contacts are in the "QRZ" list. The TNC stores the QSL list, but not the QRZ list. It is up to the ground station to capture QRZ-list data since the shuttle lap-top computer may not be available for logging packet activity.

With hundreds of stations attempting to make contact, it is good practice to only make one contact and then listen for the remainder of the mission. Only one QSL per mission will be available for each callsign submitting a request.

To get a QSL for a contact or SWL report for STS-58 or STS-60, send your card with a self-addressed stamped envelope (4" x 9.5") to the ARRL, Educational Activities Department, 225 Main Street, Newington CT 06111. Be sure to note the mission number on the outside of your envelope. Expect a long delay, sometimes up to six months. The photo for the shuttle QSL is not selected until after the mission. The cards are then printed based on the volume of requests. Volunteers take it from there to get the replies out.

What's Next

STS-59 is currently scheduled for launch in early April and will carry configuration C SAREX gear. Jay Apt N5QWL and Linda Godwin N5RAX are looking forward to their nine-day mission and amateur-radio operations. The orbit will be very low at 120 nautical miles, but the inclination of 57 degrees should cover a lot of territory in North America.

STS-65 is expected to carry ham

SAREX Configurations Component Requirements	Voice Packet SSTV A	Voice Packet B	Voice C	Voice Packet SSTV FSTV D
Antenna cavity	●	●	●	●
Antenna adapter plate	●	●	●	●
Transceiver and power adapter (one unit)	●	●	●	●
Adapter module	●	●	●	●
Recorder cable adapter	●	●	●	●
Crew Personal Recorder	●	●	●	●
Batteries	●	●	●	●
Headset	●	●	●	●
Sony camcorder (with two 8mm tapes)	●			●
Combination VCR/monitor (with two VHS tapes)	●			●
Scan converter	●			●
Packet module			●	
FSTV module				●
PGSC (not charged to SAREX if shared)	●		●	●
SAREX disks	●		●	●
Cables:				
Headset extension	●	●	●	●
Tape recorder	●	●	●	●
Sony camcorder	●			●
Combination VCR/monitor	●			●
Camcorder/monitor extension	●			●
Shuttle video	●			●
Transceiver	●		●	●
PGSC DC power (not charged to SAREX if shared)	●		●	●
Shuttle DC power (not charged to SAREX if shared)	●		●	●
PGSC RS232 (9-pin)	●		●	●
FSTV				●
Antenna cable	●	●	●	●
Motorola cable	●	●	●	●

Figure 1. Current configuration possibilities of SAREX.

Photo C. Bill McArther KC5ACR with the packet gear on STS-58. (NASA photo.)

gear in July, once again with configuration C. The altitude will be 160 miles with a 39 degree inclination and should last 14 days. Due to the use of a side window for the antenna and the orientation of the spacecraft for this mission, the passes may be short due to shadowing of the antenna with respect to ground stations.

STS-64 is to be a September launch with configuration B SAREX gear. Power from the spacecraft for the ham gear is not currently available, so batteries will be taken. It is hoped that the situation will change before flight to allow power for packet operation and configuration C activity. The flight is set for nine days with an altitude of 140 miles and an inclination of 57 degrees.

More flights are expected for 1995, most with packet and voice, but a return of SSTV and even digital TV are being studied as possibilities.

The Future

What's ahead for SAREX? NASA's Principal Investigator for the program, Lou McFadin W5DID, believes that a permanent ham shack for the space station is the goal. Efforts are underway to coordinate a 2 meter FM rig with an outside antenna into the station's design. Anticipated Doppler shift precludes the use of higher frequencies, but all potentially useful systems will be considered.

Sample Conversation

W5RRR-1>SAREX [02/05/94 13:08:13] <UI>:
This is STS-60 SAREX Robot station W5RRR-1 onboard the Space Shuttle Discovery.
cmd:c w5rrr-1
*** CONNECTED to W5RRR-1 [02/05/94 21:08:52]
#926-is your STS-60 SAREX QSO number.
*** DISCONNECTED [02/05/94 21:08:56]
.
.
W5RRR-1>QST [02/05/94 22:40:43] <I S4 R0>:
Greetings from the crew of STS-60! Our current altitude is 190 nautical miles above the beautiful Earth that is the home for all of us. We are very busy with Spacehab experiments and hopefully today we will deploy the Wake Shield Facility
W5RRR-1>QRZ [02/05/94 22:42:07] <UI>:
#544-N6GIW K8SIN WB5UUK N7LQT N6YIE KE8GR KW7E KJ6HO GØERY KC8UD
N6VMS KØRI K7ZTM WB6GXX WA6LIE N8CLF KF6BM DL5KR KD6RJU W6GBF W6BME
WA5DJJ KR2C N7VWJ VE7ZR WA7DEO KD7LT N7INB AA7NI KB7WGC KB7ADO
W7TIZ N7KIO WA7QCC WB6FJE
W5RRR-1>QSL [02/05/94 22:42:08] <UI>:
DL5KR/976 KD6RJU/975 N7OFW/951 JH1DWU/948 JH3FDA/943 CO2VV/938
K4HVK/934 WA5ZIB/926 NØNTW/923 WA5NOM/922 NØULV/918 N7SFI/914
NØIYN/911 KB9E/908 9Y4DG/893
.
.
W5RRR-1>QRZ [02/06/94 21:33:33] <UI>:
#956-KI5UA NØSEG AB4EG KE7NS N7ZEF KDØGC KFØCT N9VDO NØULV KB7WAU
AAØHL K7RD NØIVN KB7WGC KV4KE KI7JM N7KMJ K7YCH N7UVF KB7QLY KW7Y
NL7OD VE7XQ AL7PB AL7BX WL7EF NL7RY WL7CX NL7RK AL7NO KL7GID KL7JAU
WL7EP JS1JIO JH4DHX
W5RRR-1>QSL [02/06/94 21:33:34] <UI>:
AL7BX/1634 WL7CX/1630 NL7VR/1628 WL7EP/1625 WL7CN/1623 JR4GMO/1613
JA2BGX/1612 JH2VHL/1609 KO4EI/1590 KB1SF/1584 N8BJN/1583 NL7ZL/1567
N9UDO/1547 WB2ELB/1530 KA9QFJ/1521
W5RRR-1>SAREX [02/06/94 21:33:34] <UI>:
This is STS-60 SAREX Robot station W5RRR-1
onboard the Space Shuttle Discovery.
W5RRR-1>WB5UUK [02/06/94 21:34:13] <UA>
W5RRR-1>WB5UUK [02/06/94 21:34:14] <I S0 R0>:
#1671-is your STS-60 SAREX QSO number.
W5RRR-1>QST [02/06/94 21:34:34] <I S3 R0>:

Hello from the crew of STS-60, Discovery! We've enjoyed several school contacts with students from Boise, ID, and Moscow, Russia, so far as well as a number of voice contacts at random. The views of the world from our orbit continue to be spectacular! We're working very hard with our mission control at present to get the Wake Shield Facility ready for deployment. We encountered problems communicating with it yesterday causing us to cancel the initially planned deploy. The STS-60 Crew

Figure 2. Edited sampling of STS-60 packet operation.

RTTY LOOP

Number 16 on your Feedback card

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
6 Jenny Lane
Baltimore MD 21208

The AEA CP-1

As has been evident by the several questions appearing in these pages over the last few months, interest in old equipment is far from over. In particular, the AEA CP-1 Computer Patch Interface has been the center of many a ham's efforts.

Introduced by AEA about 10 years ago, the CP-1 was one of the first RTTY modems; that is, modulators and demodulators, produced with the amateur computer station in mind. For its time, this was quite a unit. With a fixed 170 Hz shift and variable shift capability, it allowed just about any transceiver to operate on RTTY, with an appropriate software package. Originally, an interface option was available from AEA for adding an RS-232 port to the CP-1. However, sometime in late 1988 Texas Instruments ceased manufacturing two integrated circuits, the 75150 and 75152, which were the foundation of the interface. When the supply of these ICs ran out in early 1989, AEA was unable to continue sending an option kit for the RS-232 port.

Figure 1 shows a method for creating an RS-232 interface using a 1488 and 1489 integrated circuit (chips available at Radio Shack and many mail order distributors).

Referring to the diagram, U-1 is a 1488, U-2 is a 1489. All other designations, U-13 and U-12, refer to the silkscreened layout on the CP-1 printed circuit board. On the CP-1, resistors R-99 and R-100 must both be 1k ohm resistors. Ignore the values listed in the schematic. Those values in the schematic referred to the original design; the 1k ohm values work with the 1488 and 1489. Ground for U-1, pin 7, can be obtained at U-13, pin 8, the same place U-2 is grounded.

Now, NØCHP circulated another scheme last year, in which he says that the CP-1 can work on RTTY, CW, AMTOR, and even PACTOR with programs like HAMCOM, PCTOR, etc. However, AEA, in the original instructions for the RS-232 port using the 1488 and 1489, go a roundabout way. The following is much easier to wire up and understand:

Install JP 7, 10, and 3. Set JP 11 to +12 volts. *Now the difference:* On the CP-1 RS-232 port jump pins 5 & 20 (this sends modem output to pin 3 and takes data for transmission to pin 2). Jump pins 3 & 8 (this allows it to receive/transmit Baudot, ASCII, and AMTOR). Wire both ends of the RS-232 cable exactly the same, and do not wire any pins but these:

Pin 1	Frame ground
Pin 2	Send data
Pin 3	Receive data
Pin 4	Ready To Send
Pin 7	Ground
Pin 8	Carrier Detect

Now, if a Macintosh owner wants to try to use this, using a standard modem cable and appropriate software, it should work.

The CP-1 can be connected to a Commodore C-64 directly, as well, as shown in Figure 2. This uses the TTL levels available at the ports, so no modification to either unit is required. Once again, appropriate software in the host computer is essential. The "RTTY Loop" disk collection, as detailed previously, has several programs which may be of help. Additionally, a new Disk #5 is available, with some of the newest PC compatible programs around. As always, each collection may be yours for a disk, 3.5" 1.44 Mb preferred, self-addressed stamped return mailer, and $2 per disk, sent to me at the above address. Feel free to drop me a self-addressed, stamped envelope for a listing of programs, or send Email to me on CompuServe (ppn 75036,2501) or America Online (MarcWA3AJR) and I'll forward the list to you via Email. While I'm on Delphi as well (MarcWA3AJR), I have yet to forward a file via Email on that system.

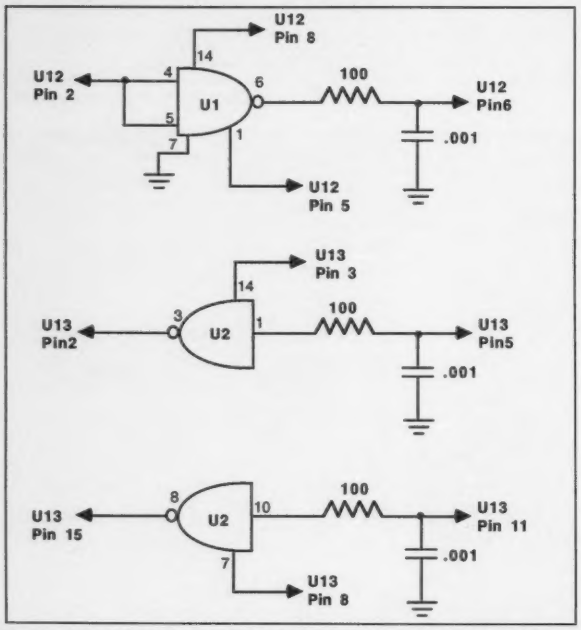
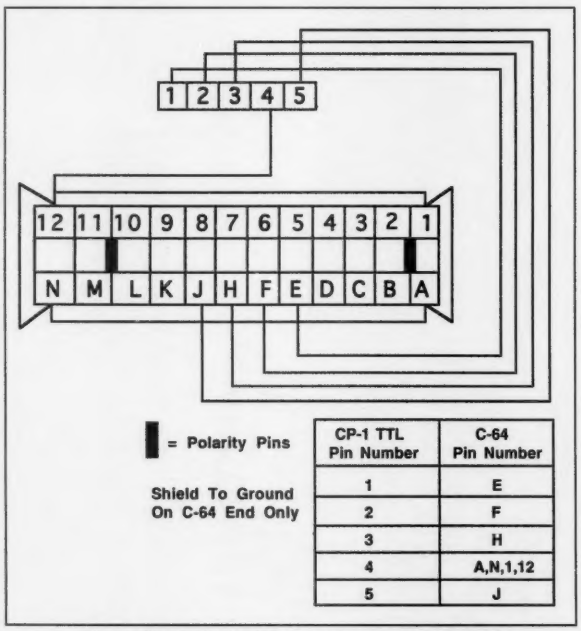


Figure 1. Method for creating an RS-232 interface using a 1488 and 1489 integrated circuit.



CP-1 TTL Pin Number	C-64 Pin Number
1	E
2	F
3	H
4	A,N,1,12
5	J

Figure 2.Connecting the CP-1 to a Commodore C-64 directly.

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

For Long Ham Equipment Life . . . GET THE HEAT OUT!!!

Experienced electronics professionals know that heat is the great killer of electronic devices. Equipment that passes or delivers large amounts of either current or power must be kept cool for proper operation. The methods given in this month's column are simple, yet are sufficient for most applications. While reliability engineers and thermodynamicists will flinch at the lack of mathematical elegance in this approach, the methods are nonetheless effective for most practical ham radio applications.

There is only one simple rule: Where there is excessive heat, remove it.

But, as they say, "the devil is in the details." What does "excessive" mean? If the equipment feels too hot to the touch, or has a history of unexplained failures or repairs, then it is probably running too hot. An engineer will have specifications to meet and calculations to make, but they are beyond the scope of this column. The practical "takes off the skin of the thumb" rule suffices for our needs.

Consider some practical examples. I know of a medical central monitoring station in a hospital that once suffered from heat exhaustion. The monitoring console contained oscilloscopes that were slaved to bedside monitoring sets in the coronary care unit (CCU). The carpenter who built the console was a master craftsman in wood, but did not understand electronics worth a squat. He completely enclosed the monitor—a pretty nice installation, except that there was no ventilation. The service technicians in the hospital had to be summoned in the middle of the night, on the average of once a month. This was not only expensive, but it placed the patients at risk as well.

Another example was seen in consumer electronics servicing. A low-cost compact stereo unit from Japan was causing the importer fits because warranty returns were terrible. Shops were awash with returned units. Adding insult to injury, the repaired units often returned again before the original warranty expired. An enterprising technician began installing sheet metal heat sinks on the TO-5 audio output transistors (it was a relatively low-power unit), and his work didn't return. The service manager noted that fact, and issued a service guidance letter to all warranty stations ordering heat sinks installed on all units returned. Subsequent modifications from the manufacturer included heat-sinking.

There are three basic tactics which can be used in any combination to remove heat: 1) radiate more of the heat; 2) improve natural ventilation; or 3) add or increase forced-air cooling. Water cooling is not an issue for most hams, although some commercial broadcast transmitters and high-power industrial electronics devices use circulating water for cooling. (Some broadcasting stations use the waste heat from the transmitter's water radiator to heat the transmitter building).

Protecting Transistors & IC Voltage Regulators

Semiconductors are especially prone to heat damage, so manufacturers often take special care to rid solid-state circuits of heat. In both of the examples presented above the parts causing the problems were the semiconductors. In the case of the hi-fi gear it was obvious, but in the hospital case, analysis of the service records indicated that DC power supplies and cathode ray tube deflection amplifiers were the main printed wiring boards replaced. Further analysis by the manufacturer showed that it was primarily the voltage regulator transistors on the power supply, and the output amplifier transistors on the deflection circuits. Electronic reliability experts note that semiconductors should be operated such that the junction temperatures inside the transistors are kept at 110°C or less, even when rated at 125°C. According to one reliability handbook, the mean time between failure (MTBF) of semiconductors is cut in half for every 10°C increase in junction temperatures. Thus, even small improvements in the temperature situation can make a tremendous difference in the final product.

On some small equipment it is not practical (or possible) to use forced air cooling, so you will have to provide heat-sinking for the semiconductors. In fact, even in most forced-air cooled equipment the semiconductors will need these metal radiators. Figure 1a shows the metal TO-5 transistor package. Most of these transistors are mounted on printed wiring boards, and are low-signal (and low-heat) devices. But certain TO-5 transistors, such as the 2N3053, 2N5109 and certain 3 to 10 watt RF power transistors, operate at moderate power levels. A "top-hat" finned heat sink, such as that shown in Figure 1b, is mounted on the TO-5 package to radiate heat. There are also certain other "spring clip" versions of this same kind of heat sink.

Figure 2a shows two different plastic power device packages. You will find these packages in audio power transistors (e.g. 2N5249), thyristors and three-terminal IC voltage regulators. In the regulator case, the devices are usually rated at 750 mA in free air and 1,000 mA when heat-sinked. These devices are frequently used at higher power than they are rated for! Either vertical or horizontal finned sheet metal heat sinks, such as that shown in Figure 2b, are used to provide heat dissipation. Be sure to use a thin layer of silicone heat transfer grease between the metal tab surface on the transistor (or regulator) and the heat sink. Also be sure to tighten the mounting screw properly in order to fa-

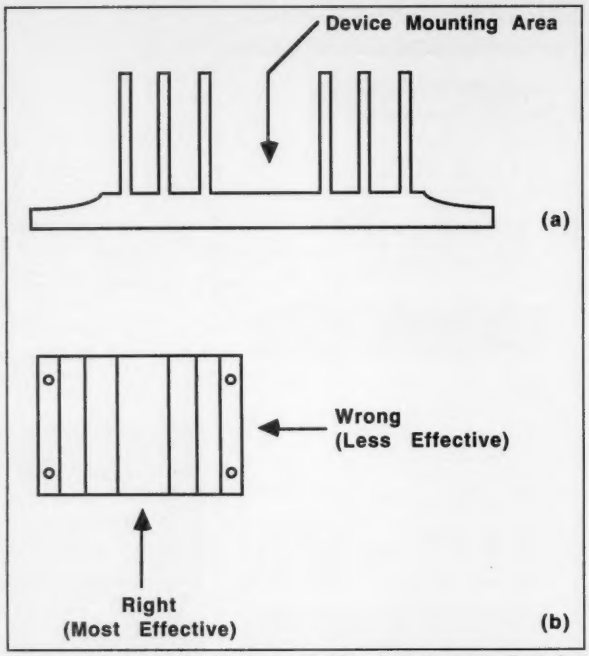


Figure 3. a) Power transistor heat sink; b) right and wrong ways to direct air at heat sink.

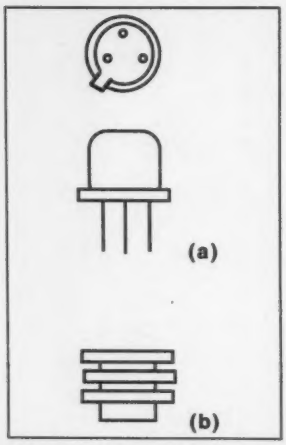


Figure 1. a) TO-5 transistor package; b) TO-5-style top-hat heat sink.

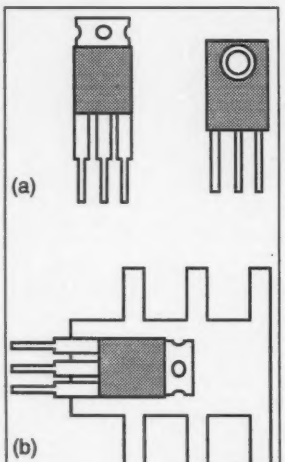


Figure 2. a) TO-220 and other plastic power transistor package; b) TO-220 device mounted to sheet metal heat sink.

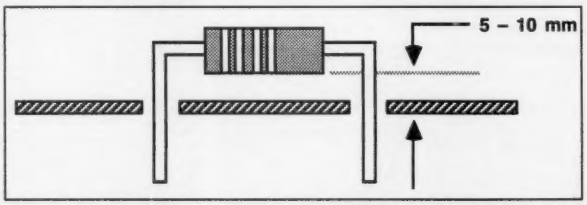


Figure 4. Power resistors (1 watt and up) should be mounted off the board surface.

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CIRCLE 159 ON READER SERVICE CARD

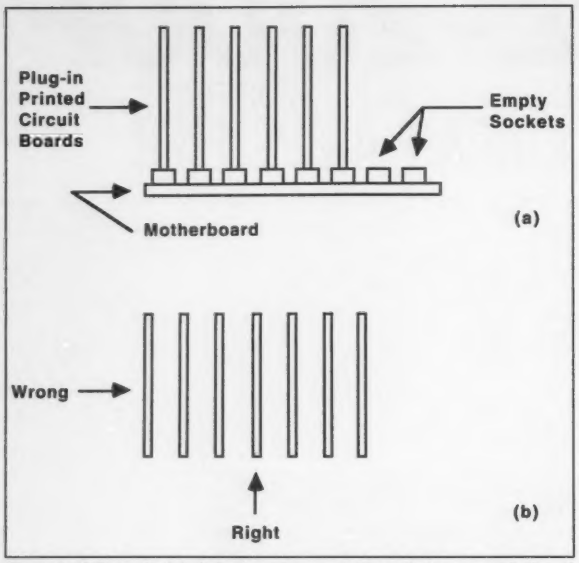

Figure 5. a) Several printed circuit cards mounted in sockets on a motherboard; b) right and wrong ways to direct air over the printed circuit cards.

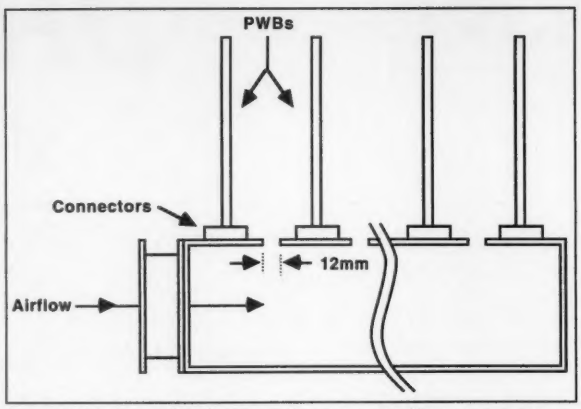

Figure 6. Holes in an otherwise closed chassis were used by one computer manufacturer to direct air over PWB surface.

cilitate heat transfer to the heat sink.

Sheet-metal heat sinks for TO-3 transistors and three-terminal regulators are mounted on a printed circuit board. The bent sheet metal heat sinks are good for up to about 10 watts of power, or voltage regulators up to 1.5 amperes. For the 3 ampere, 5 ampere and 10 ampere voltage regulators that also use a TO-3 package it would be better to use a larger finned heat sink.

In many pieces of equipment the metal chassis is used for heat-sinking. In those cases the transistors are bolted either directly to the metal chassis or mounted via mica insulators if electrical isolation is required. In both cases, silicone heat transfer grease is used between the semiconductor device and the chassis. This method is especially successful when the chassis is large, or when it is particularly thick (i.e. has a high "thermal mass").

Some printed wiring boards (PWB) use large areas of unetched copper foil and/or large metal ridges or blocks to provide better heat-sinking. This method is used especially where there are no single devices that can be individually heat-sinked (e.g. a TO-220 transistor), but rather a large number of heat-producing devices such as TTL ICs.

There are many different forms of large, finned heat sinks used for TO-3 (and other) transistors, high current voltage regulators and high-current diodes and SCRs; Figure 3a shows a side view of one of these heat sinks. In this case, the TO-3 transistor (or other device) is mounted with screws on the flat central surface of the heat sink. In most situations, it is wise to use a thin smear of silicone heat transfer grease

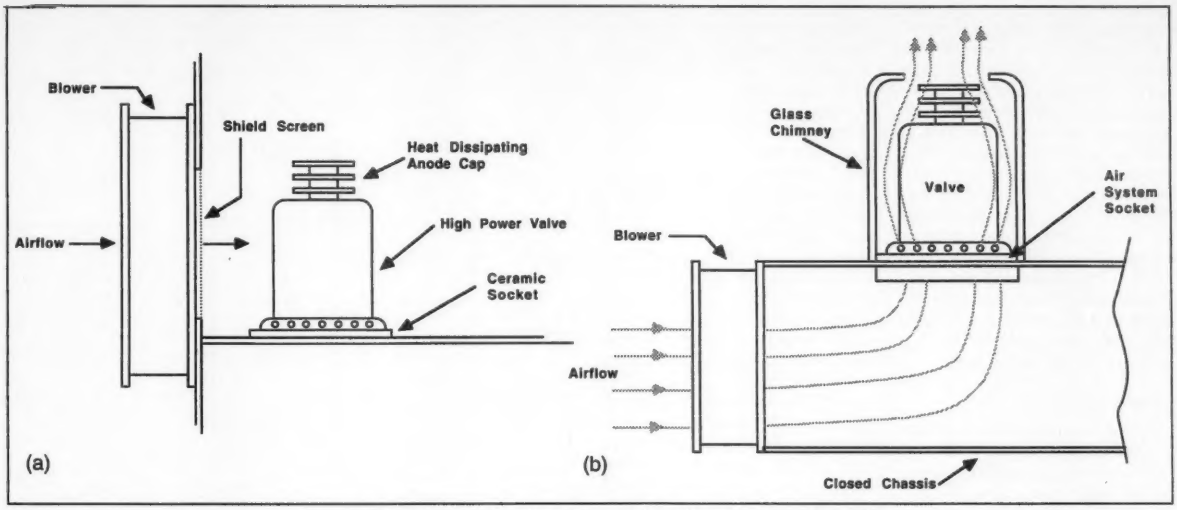

Figure 7. a) Direct method of cooling RF power tubes; b) use of an air system socket.

between the device and the heat sink. This grease is especially needed when a mica insulator is placed between the semiconductor device and the heat sink. Again it is necessary to make sure that the mounting screws are cinched down tight enough to allow maximum heat transfer (but not enough to distort the device package). The big issue in selecting a heat sink is the surface area.

When forced air is used to cool a heat sink—a good idea when the power and/or current is high—the orientation of the heat sink with respect to the airflow is sometimes important. Figure 3b shows the right and wrong ways to force air over the finned surfaces. Keep in mind, however, that orientation is not always critical, especially when air from the "wrong" direction is sufficient or blows over the entire surface. The designations "right" and "wrong" are merely general considerations for some critical applications.

Microprocessor chips are no different from other semiconductor devices: Heat kills them. To make matters worse, speed beyond the designer's specified speed often generates excessive heat inside the chip. Some low-priced computers operate cheaper lower-speed chips at a higher clock rate, but at the cost of decreased reliability. Even in well-designed computers, reliability improvement is possible by cooling the microprocessor chip.

Some 486 personal computers add a second fan on the back of the cabinet, in addition to the one in the DC

power supply, in order to cool the very high-speed chips on the motherboard. Other vendors offer a clip-on fan that mounts above the 486 chip and blows air on it directly. These fans are designed to rob power from one of the computer's disk drive power connectors. In the JDR Microdevices (2233 Samaritan Drive, San Jose CA 95124) catalog there is a "refrigeration" clip-on fan for 486 chips. I suspect that this device has a Peltier-effect solid-state refrigeration unit embedded in the fan block. Some vendors of computing stuff tell me that they won't sell a 486 machine rated at more than 33 MHz clock speed without installing the clip-on fan to cool the main chip.

Other Components

Certain components other than power transistors generate heat. Rectifier diodes, bridge rectifier stacks and power resistors are prime examples. How these components are handled is critical in determining the reliability of electronic equipment.

Rectifier diodes and power resistors should be mounted with their bodies 5 mm to 10 mm from the Printed Wiring Board (PWB). Please see Figure 4. This procedure allows the heat to dissipate into the air instead of into the PWB material. Many phenolic and some Fiberglas printed wiring boards can be badly damaged from the effects of a 10 watt power resistor mounted flush to the surface. Some "bargain basement" or "grab bag" rectifier diodes can meet their rated forward current only when the rectifier is a) mounted 10-15 mm off the board, and b) have the axial leads cut to 20 mm or longer. Those diodes are overrated and should either be used only in lower than the rated current applications or shunned entirely.

Besides reducing the operating life or limiting the power output of circuits, overheating can also decrease performance in other ways. Certain circuits, oscillators for example, are inherently sensitive to heat. There was once a popular two-way radio transceiver that suffered terrible frequency drift because the master oscillator was located right next to the RF/IF strip vacuum tubes. Although that was such a bad design error that nothing would really "fix" the situation, a lot of technicians improved the frequency stability markedly by adding some thermal insulating material between the RF/IF PWB and the aluminum oscillator shielded housing.

Large Multi-Board Equipment

Figure 5a shows a piece of typical large-scale multi-board equipment, such as a microcomputer, in which plug-in printed wiring boards are installed on a socketed motherboard. Usually, these PWBs will be mounted in a closed cabinet for both Electro-Magnetic Interference (EMI) and aesthetic reasons. If we apply air broadside to the PWBs, only the first one in the lineup will benefit. Figure 5b shows a top view that permits you to see right and wrong airflow directions. Obviously, air coming in from the sides is better able to remove heat from more of the PWBs.

Figure 6 shows a method that was used in a minicomputer a few years ago. There is a large metal chassis with a motherboard mounted on it to hold the PWBs. There were several 12 mm holes cut in both the chassis top and the motherboard to admit air between the boards. Although only one hole is shown between each board in this side view, there were four per row in the actual computer. Air from the blower flowed up through the holes and across the electronic components on the PWBs.

Radio frequency power amplifiers and high-power transmitters pose special heat problems. Some linear power amplifiers, for example, are only 45 percent efficient. Therefore, a 1,000 watt linear amplifier delivers 450 watts of usable RF power and 550 watts of waste heat. To make matters even worse, the necessity of keeping harmonics inside the transmitter means buttoning up all that heat inside of a shielded metal cabinet.

Most RF power amplifier tubes used in ham radio transmitters must be forced-air cooled in order to realize their full ratings. (Some are absolutely dependent on cooling.) Figure 7 shows two methods for providing the needed cooling air. In Figure 7a we see the situation where a blower is mounted so that the air flow is directly over the glass envelope. The fan may be mounted either exterior to the RF compartment (as shown) or inside.

The other method, shown in Figure 7b, assumes the use of "air system" tube sockets. A blower or fan supplies air to the bottom side of the socket, and the air is directed upwards through holes in the socket and around the glass envelope. A "chimney" aids in keeping the airflow against the glass. Some air system sockets have plumbing connections for the air hose, while others are dependent upon pressur-ization of the lower compartment. In either case, the reason this socket is better is that the lead seals in the glass are kept cooler. The plate cap lead seal should also be kept cool, if possible. Toward this end some builders use a finned "heat dissipating" plate cap to make electrical connection to the anode.

IC Printed Circuit Boards

The component density possible on modern printed wiring boards (PWB) makes it possible to make very small, high density products such as modern radio communications equipment and digital computers. Unfortunately, as the number of IC devices on a card increases, so does the problem of cooling them off. In some cases, impingement airflow, as discussed earlier, is neither feasible nor desirable, but we still have to remove the heat. One solution is shown in Figure 8. This method uses a ladder heat sink built onto the board.

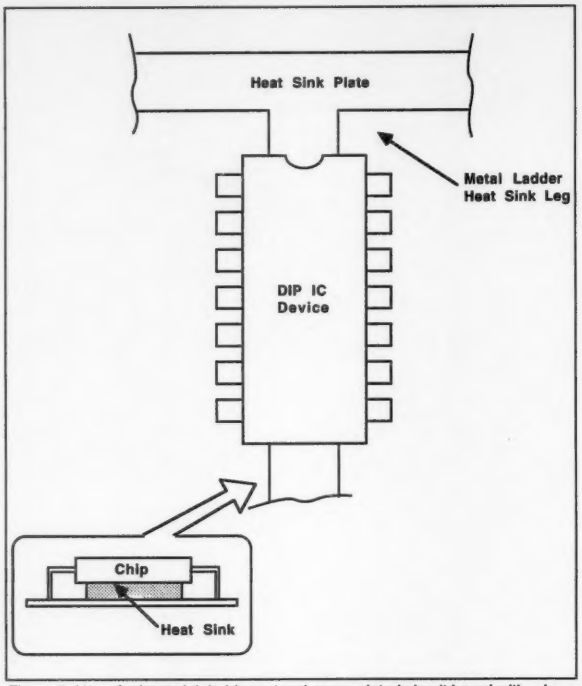

Figure 8. Use of a heat sink ladder network on a printed circuit board with a large number of ICs (particularly important in large TTL boards).

In Figure 8, a heavy metal "ladder" is run underneath each IC device (see inset) and is joined to a large heat sink bar on the card edge. Heat is removed from the IC area by conduction. In some cases, air flow can de directed across the card edge heat sinks. In this type of construction, we usually want to place the most heat producing components as close as possible to the edges of the PWB where the heat sink bar is located.

A neat trick used in some commercial and military equipment, although less practical for hobbyists, is to enclose the chamber containing the printed circuit board and use the conduction ladder method to conduct heat to the walls of the box (Figure 9). The box walls act as a "cold plate" to sink the heat. Forced air is blown through chambers on the outside of the cold plate to carry heat away.

Conclusion

Heat is clearly the great destroyer of electronic components. If a piece of equipment runs too hot the result will be erratic operation, frequent breakdowns and all the headaches that accompany low reliability. Although it is ordinarily unwise to modify equipment without expressly written instructions from the manufacturer, there are sometimes exceptions to this rule. An obviously overheating piece of equipment that can be modified with no adverse effect is a candidate for exception to the rule. The simple methods shown in this column will permit you to modify equipment to gain the longest and most reliable use. 73

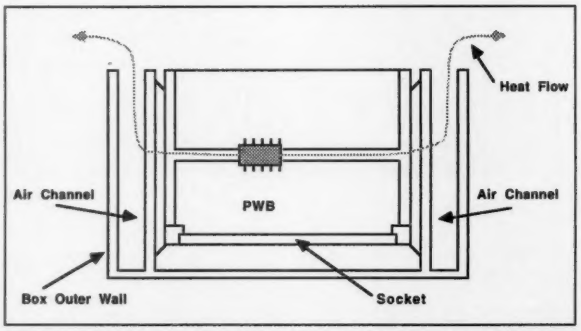

Figure 9. Closed box for mounting PWBs uses air channel and cold plate to carry away heat conducted from the printed circuit board.

Number 18 on your Feedback card

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
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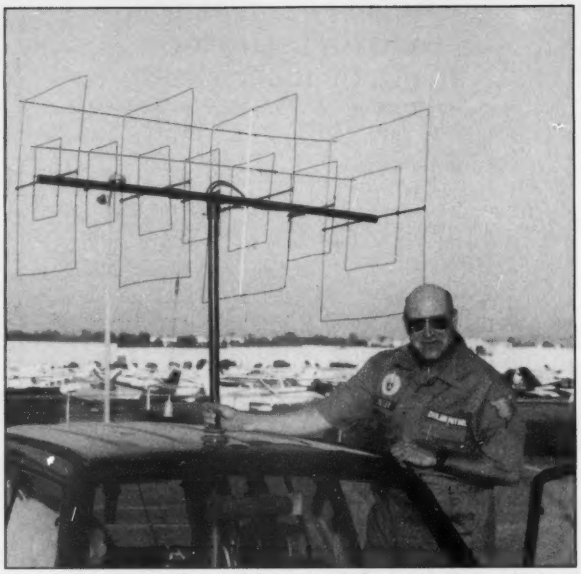

Photo A. Civil Air Patrol Captain Bob Miller N6ZHZ is testing his new dual-band mobile quad with four elements for 121.5 MHz and seven elements for 243.0 MHz. He is Commander of Brackett Composite Squadron 64 in La Verne, California.

T-Hunters to the Rescue

Last August 7 was a typical Saturday at the top of Skyline Drive in Fullerton. By 7:45 p.m. a dozen cars, trucks, and vans formed a row on the roadside. Unusual antennas—quads, yagis and dopplers—were mounted on top or through the windows of each.

I joined the circle of hams of all ages laughing and chatting, as another ham walked to each vehicle and wrote down its odometer reading. A radio direction finding (RDF) contest, called a foxhunt or T-hunt, would begin in 10 minutes. None of the hams knew where they would end up that evening, nor what they would find.

One team had broken away from the group. Bob Miller N6ZHZ and Cathy Livoni KD6CYG were removing their four-element 2 meter quad and substituting an eight-element UHF quad. Soon they would put on the blue jump suits that they keep close at hand. Bob had just been alerted by pager to the presence of an emergency beacon signal on 243 MHz.

When a pilot or a boater is in trouble, radio rescue devices bring help to the scene. Emergency Locator Transmitters (ELTs) for aircraft activate on impact to signal the location of a crash scene. Emergency Position-Indicating Radio Beacons (EPIRBs), which are manually activated by sailors in distress, share the ELT frequencies.

ELTs and EPIRBs transmit a distinctive tone to attract attention. Newer ones transmit digital registration data, too. But despite their names, they do not transmit the coordinates of their location, so they must be found using RDF techniques. As members of the Civil Air Patrol (CAP), Bob and Cathy are always on call to begin tracking when a beacon comes on the air in the Los Angeles metropolitan area.

CAP, an auxiliary of the US Air Force, is a non-profit organization of aviation-minded civilians from all walks of life. The California wing of CAP is responsible for tracking all on-shore ELT/EPIRB activations in the state and performs air/ground searches when crashes occur.

Civilian ELTs, some military aircraft ELTs, and most EPIRBs transmit on both 121.5 and 243.0 MHz. Other military aircraft and survival beacons emit only on 243.0 MHz. The newest EPIRBs transmit on 121.5 for 50 seconds, then send a short data burst on 406.025 MHz.

A Sleepy Seaman

The next morning, as T-hunters rehashed their competition on a UHF repeater, Bob told the story of his and Cathy's evening. They had traced the

Photo B. Cathy Livoni KD6CYG publishes the official T-hunt calendar and hunt list for Southern California. She recently joined CAP and uses the Little L-Per to sniff out emergency beacon transmissions.

243 MHz signal to a home 17 miles from the hilltop, where a US Navy man was asleep on a couch with a personal EPIRB lying next to him.

"The sailor had found the beacon in an emergency provisions bag he had purchased from another sailor aboard ship," Bob announced. "He didn't know what it was. He had been playing with it and managed to turn it on. He was tired because of his long driving trip from port, so he put it down and went to sleep."

Whenever possible, pilots monitor ELT frequencies for rapid discovery of activations. Since the mid 1980s, however, most transmissions are detected by satellites in the SARSAT/COSPAS program. Three Russian COSPAS birds monitor 121.5 and 406.025 MHz. Three US SARSATS hear these frequencies, plus 243.0 MHz.

The low-orbit high-inclination tracks of SARSAT/COSPAS satellites put one over any given point on earth about every two hours. Doppler shifts of the downlinked beacon signals are computer-processed to determine their point of origin. Accuracy of the fixes varies from dead on to 20 miles off, depending on the signal quality and the satellite path.

Beacon signals received by satellites are relayed by downlinking terminals to SARSAT/COSPAS mission control centers. Coordinates of US "hits" are passed to the Rescue Coordination Center at Langley Force Base in Virginia, which in turn notifies the agency having jurisdiction. If it is the Civil Air Patrol, a local Mission Coordinator (MC) is assigned and volunteers are alerted by phone, radio, and pager.

Speedy RDF Saves Lives

CAP's Lt. Col. Pat Robinson WA6OIS began tracking ELTs when they were first mandated for aircraft in 1972. Since that time, she has discovered three unreported crashes. As we talked, her dog Jody tugged continuously on her leash. "I first got a search dog after we accidentally walked by a crash at night in the Santa Ana mountains," she told me. "We smelled the smoke but thought it was coming from a campfire below us."

There are over 4,000 dues-paying CAP members in California, but only a few are RDF experts. Pat, Bob, and Cathy are dispatched to find about 90 percent of the activated ELTs and EPIRBs in the Los Angeles basin each year, coordinating their searches on one or more of the seven Southern California CAP repeaters just outside the 2 meter ham band. They say that 98 percent of the reported beacon transmissions are accidental, not calls for help.

According to Pat, "We have found activated ELTs and EPIRBs in almost any place you can imagine, including a dumpster in Costa Mesa, a junkyard in Oxnard, a UPS container on an incoming train, and even in one of our own CAP planes. One night I was involved in turning off an ELT on an L-1011 at Ontario airport. It was being delivered to an Arab oil baron the next day, with $17M worth of modifications. The bathroom had gold fixtures."

"Occasionally I go as long as a month without a call, but sometimes I get three in a day," Bob says. "They bunch up in bad weather. It seems like I have found half my ELTs in the rain. Often water leaks into a plane and causes a short across the power switch. These are the hardest to find because they have marginal signal, often with no

modulation. They may be intermittent, disappearing after the rain stops."

Since many false ELT activations occur in hangars, CAP has convinced some airports to buy their own RDF sets, so that when ELTs are reported, airport personnel can secure them quickly. Harbormasters have not done this, however. "I've done more hunting of EPIRBs lately than ELTs," says N6ZHZ. "I've found them in vessels of every size, even in a jet ski!

"One day, after the Coast Guard had been searching unsuccessfully for an EPIRB, CAP was called for assistance. I went to the harbor where there was a helo circling, trying unsuccessfully to DF the unit. After a few minutes, I found it. It was on one of the Coast Guard's own cutters!"

WA6OIS tells of tracking a signal to a vessel at the Wilmington boatyard. "It had barnacles all over everything, including the glass, and it smelled to high heaven. The EPIRB was inside the cabin. The boat had sunk, staying under 60 feet of water for four months without the device activating. After they pulled it up and the water drained out, the EPIRB tipped over and turned on. We switched it off and left a note on it. The next day we were called out and ended up finding the same beacon, moving this time. Someone had found it and was taking it home in a truck."

Any signal on 121.5 or 243 MHz can interfere with the sensitive satellite tracking system. FCC regulations call for shielding of computers and other devices that can emit RF on these frequencies. Your local cable company cannot use channels containing ELT/EPIRB frequencies unless it can demonstrate adequate system shielding.

CAP RDFers frequently have to track down such sources of QRM. "It doesn't take a lot of RF to key some of the satellites," Bob says. "We turned off an interfering word processor one evening. I got a call the following morning from the MC saying that it was back on. I went back to find out that it was still off. The signal was coming from an identical model in the office next door. I looked at the serial numbers on the two and they were consecutive."

Don't Mess With These T-Hunters

Persons who accidentally activate ELT/EPIRBs or create interference on their frequencies must immediately cease their emissions when notified or face prosecution. "Most people are cooperative," says Pat, "although one man threatened to shoot us."

CAP's beacon searchers can get prompt backup from the authorities when necessary. N6ZHZ had to overcome resistance from the employees and night manager of a telephone company repair center. "He refused to turn the offending piece of test equipment off," says Bob. "I had the Mission Coordinator call him, and he rudely told the MC to 'go pound sand.'" So the MC had an Air Force Colonel call to politely explain the situation. Again, he didn't recognize anybody as having jurisdiction to tell him to turn off his test equipment, and he used four-letter words to say so.

"So the Air Force had the FCC and a US Federal Marshall go out the following morning with a search warrant. They arrested the facility manager as he came in, arrested the night manager

Photo C. With over 20 years of experience, search and rescue volunteer Pat Robinson WA6OIS is quick to embrace new technologies such as satellite navigation units. CAP makes extensive use of these devices to pinpoint crash locations.

who had given them a hard time, and seized the offending equipment. It went to court, and based on my written statements and deposition, the night manager ended up with a 2-1/2-year prison sentence, which was commuted to probation. They fined the phone company $10,000, and the facility manager was fined, too."

N6ZHZ credits ham radio with helping him develop his RDF expertise. He began T-hunting three years ago. "I couldn't find anybody to train me in the CAP," he says. "Then I got into amateur radio and met the Southern California T-hunters. It didn't take long before I was hooked."

But beacon hunting is quite different from foxhunting. "On a mobile mileage hunt, you get a comforting level of signal at the starting point," says Bob. "There's not a real sense of urgency to go get it. Whereas with the ELT, you often start out without hearing the signal and wondering when you'll be able to."

When his beeper sounds off, Bob knows lives may be at stake. "There's more of an adrenaline rush hunting ELTs," he says. "But the same skills apply. The hardest thing for me to do is bounce back and forth. In ham T-hunting, teams don't share information. The rule is—no clues! In CAP, the object of the game is to share signal strength and bearing info, and try to get somebody to find the transmitter as rapidly as possible. It takes a change of mindset."

Searching on foot for a signal at close range is sometimes called "sniffing" by ham foxhunters. Bob says his sniffing skills get a real workout in CAP searches. One night he tracked a 121.5 MHz signal to a storage room in an airline's repair facility at Los Angeles International Airport. Inside were 800 ELTs! Which one was transmitting? Bob's sniffing equipment led him to a corner of the room, where a box of beacons had accidentally been placed on the power switch of one ELT, turning it on.

L-Pers Versus Quads

The Little L-Per by L-Tronics of Santa Barbara, California, has become the de facto standard RDF set for beacon tracking. It has two vertical dipoles on a wooden frame, plus a sensitive receiver. In the DF mode, the dipoles are switched rapidly between two cardioid patterns, giving a sharp left-right directional indication on the panel meter.

Operation of the L-Per appears the same as Time-Difference-Of-Arrival sets described in previous "Homing In" installments, but its design principle and circuitry is quite different. Whereas TDOA units work only with FM receivers, the L-Per uses AM detection for optimum performance in the AM aircraft bands. Many hams use L-Pers for foxhunt sniffing, but the receiver's four crystal-controlled channels limit its versatility on ham bands.

Like many other CAP RDFers, Pat uses a pair of mobile whips with her L-Per when driving. Her dash-mounted indicator tells whether the signal is left or right and includes a signal-strength meter. "I can't turn the antenna," she says, "so I turn the vehicle. In the city, if it's off to the right, I turn right, go to the next street and see where it goes from there. L-Tronics recommends a second set of antennas to indicate fore and aft, but I like it this way. I can make a big circle and point right to the target. I can almost pick out the exact plane from across an air field."

Bob wants CAP to add high-gain antennas like quads and yagis to the equipment pool. "My quad has a lot more gain," he says. "And you can add it to the L-per receiver for very high sensitivity and increased range. I can rotate the quad and not have to turn the car to get a precise heading. I can twist the boom to horizontal polarization to reduce re-radiated signals from airport antennas and structures. My biggest problem is convincing people to drill holes in the roofs of their cars.

"With the quad, I am able to pick up a 243 MHz ELT two to five miles miles before the L-Per's antenna will hear it. When there are two or three ELTs chirping simultaneously in hangers at an airport, I can use a high-gain quad to track one at a time, listening to the differences in tone sweep rate of each one."

Help Wanted: T-Hunters Please Apply

The Patrol needs more RDFers and search/rescue volunteers, especially in Florida and California, where the most ELTs and EPIRBs are registered. "Here in California, we do the most search flying of any state," boasts Pat. "We go out in all kinds of weather."

"We cover a wide variety of rugged terrain, from coastline to mountains to flat desert," Bob adds. "So we have strict membership qualification requirements and a thorough training program, plus regular exercises. We can't go out to look for a pilot and then have to turn around and rescue our own."

Men and women over 18 years of age can become full CAP members. Boys and girls over 13 who have completed sixth grade are eligible to be CAP cadets. CAP provides vehicles, aircraft, and RDF gear for searches and training. But the most active searchers eventually buy their own, to ensure reliability and instant availability.

A tip of the hat to these three hams, plus all others who are using ham radio techniques to help save lives. If you want to learn foxhunting techniques and participate in an important public service, CAP can use you. If you win lots of T-hunts and are willing to respond to phone calls in the wee hours, CAP needs you. Inquire at your nearest airport to find out about local CAP RDF activity. If that doesn't work, contact CAP National Headquarters at Maxwell Air Force Base, Alabama 36112. The phone number for CAP Personnel Center is (205) 593-5463. 73

Number 19 on your Feedback card

HAMS WITH CLASS

Carole Perry WB2MGP
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Staten Island NY 10313-0006

Remembering the Forgotten Art of Memory

In a recent graduate course I was taking, the professor asked how many of us thought that memory could be improved by exercising it—that is, to memorize dates, poetry, and so on. Then he asked how many of us thought that, like certain genetic traits such as eye color, you can't do anything about improving your memory.

The answer, according to the latest psychological research, is neither. Memory isn't a muscle, so exercise doesn't make it stronger. Yet, according to my professor and others who research the vagaries of human memory, there are things you can do to improve your memory.

As a teacher of ham radio, I of course have many situations where I have to tell the kids to simply memorize something. In my opinion, memory strategy is a very important skill to teach. Good memory skills can enhance the learning of "higher order" skills such as comprehension and critical thinking. Memory skills can help children master the basics so they have the tools to build on for higher-level concepts. I am always amazed at how many children are lacking in the simplest of organized methods of how to retain and then retrieve wanted data. Because so little emphasis is placed on this skill by most teachers, the kids really seem to enjoy the lessons I do on memory techniques. Now if I can only remember what they are so I can share them with you.

Any of the following seven steps can be adapted or modified to fit the appropriate age and ability group you're working with. In my experience, adults as well enjoy getting a refresher course in memorization techniques.

1. *Chunking.* This means grouping several items into one piece that's as easy to remember as a single item. We recall an acronym like UNICEF as a single name, not as six letters. Many students already know about using the word "HOMES" to prompt the recall of the Great Lakes: Huron, Ontario, Michigan, Erie and Superior.

Psychologist Laird Cermak, author of *Improving Your Memory,* urges us to make up our own chunks. His example: For a picnic, you need milk, soda, beer, salami, bologna, hamburger, napkins, paper cups and paper plates. That's a lot to remember, but you can make it easy. There are three drinks, three meats, and three paper goods. Use the first letter of each category—d,m,p—to make a word: damp (bad for picnics). Remember that, and you'll recall the categories, and then the items in each.

2. *External memory.* This refers to all physical devices that help you remember: lists, memos, diaries, and alarm clocks. When all else fails, there's always a deliberately misplaced object like a string around your finger to jog your memory.

3. *Associations.* Visual images are one effective form of association. To remember names, think of a visual link between a person's name and some facial feature, or think of a word you can make a visual association with that is a sound-alike for the person's name. You just met Jim Purdy who has a radio you'd like to buy. Think: I'll feel purty bad if I can't get the radio from Jim.

4. *Reliving the moment.* Studies have shown that sensory impressions are associated in memory to what we're learning, and later help remind us of what we've learned. If you're trying to recall a name or a fact, picture the place in which you learned it, the people around you at the time, or how you were feeling. If you're trying to remember where you lost something, mentally retrace your steps. Many students remember the names of ham radio guests I invite to class by recalling what part they personally played in the person's demonstration. Students always have a better chance of remembering an experience they've actually participated in.

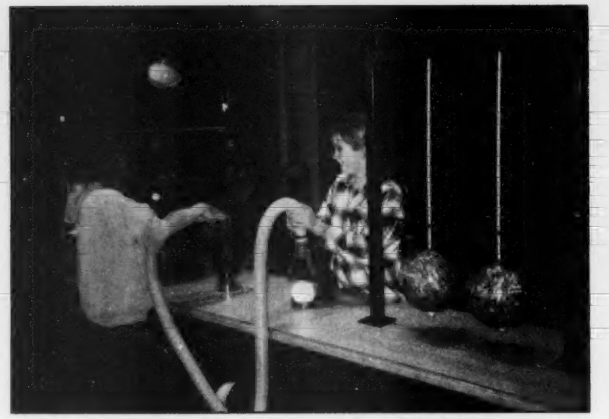

Photo A. Children remember better when they actively participate in demonstrations.

5. *Mnemonic pegboards.* We've all seen performers who remember scores of names called out by people in the audience. They don't have unusual memories; they've previously memorized a set of words or images to which they mentally attach the names. It's easy. First, memorize these 10 "pegwords." They rhyme with the numbers one to 10: one-bun; two-shoe; three-tree; four-door; five-hive; six-sticks; seven-heaven; eight-gate; nine-line; ten-hen. Now make up a list of 10 other words and number them. Link each one to the pegword with the same number by means of an image. If your first word is license, picture eating a bun while you study from your license book. If your second word is radio, picture your shoe on top of your radio.

6. *Mediation.* This means attaching the items of a list to some easily-remembered "mediating" device, such as the jingle most of us use to recall the lengths of the months: " 30 days hath September . . . " Making up your own mediators can be fun, especially when you do it with the kids in a classroom. Before leaving for Christmas vacation we made up a list of items to take care of in our classroom. We listed on the board: give out plants to children, lock up the radio and other ham gear from our shack, make sure the ham radio telephone answering machine was turned on, lower the thermostat in the room, secure the windows, bag all the garbage from our class party, lock the door with the foxlock where the radio is kept. From the first letter of each item comes the silly sentence: "Peter Rabbit takes Tums with gourmet dinners."

7. Weaving it into the web. All of the above methods are useful for recalling simple lists and names. But with more complicated information, you can't merely memorize; you have to connect it to the many related items you already know. According to psychologists, that is the best way to retrieve it later.

Now you've got seven ways to teach kids how to increase their memory power. If only you could remember them all!

Don't forget to be on the lookout for articulate youngsters who would like to be guest speakers at the Dayton Youth Forum. Please have them contact me at (718) 983-1416, or write to P.O. Box 131646, Staten Island NY 10313-0006. 73

HAM HELP

Number 20 on your Feedback card

We are happy to provide Ham Help listings free on a space available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double spaced, on a full (8 1/2" x 11") sheet of paper. You may also upload a listing as E-mail to Sysop to the 73 BBS /Special Events Message Area #11. (2400 baud, 8 data bits, no parity, 1 stop bit. (603) 924-9343). Please indicate if it is for publication. Use upper- and lower-case letters where appropriate. Also, print numbers carefully—a 1, for example, can be misread as the letters 1 or i, or even the number 7. Specifically mention that your message is for the Ham Help Column. Please remember to acknowledge responses to your requests. Thank you for your cooperation.

I am trying to help a local neighborhood crime watch group that is in need of CB radios/scanners for their crime patrols. Any type accepted: 23 channel, xtal, minor repairable, etc. Please help fight the crime that is taking over our neighborhoods, by donating those radios you no longer use. THANKS! *Rob Bellville N1NTE, P.O. Box 892, Northboro MA 01532-0892.*

I have an ICIR ASTRO 200A HF Transceiver. I Need the Instruction or Service Manual. I will cover the copy fee, or will copy it and return the manuals. I heard that the radio might have been bought by Swan and continued for a time. *John Przychocki, 115 Montague St., Brooklyn, NY 11201-3457.*

I need information on how to set up a YAESU FT-726 to tune the receiver or transmitter above and below 2 meters, 6 meters and HF Conv. ranges. Does anyone have any modifications? *N8ZAW, PJ, P.O. Box 32, Xenia OH 45385.*

I would like to purchase TTL connectors for the emerging ham population of Slovakia. Please contact me with the price, or with the names of Commodore clubs. (The C-64 is popular in Slovakia.) *Paul Taylor OM9AAK, 1 Penfield Ave., Croton-on-Hudson NY 10520.*

WANTED: Schematic and/or manual for a SILTRONICS 1011D. Vintage approx. 1976. 11 meter RCV, 28.5 to 29.0 MHz SSB XCV. I'll pay for copies and postage. Thanks. *Ron Gardin KB8KOV, 3297 West 94th St., Cleveland OH 44102-4855. Tel: (216) 961-1879.*

WANTED: Operating Manual for KENWOOD TR2400 2 meter transceiver. Will pay copy costs. *E. Danielezyk K9SXU, 9 Lloyd St., Cary IL 60013.*

QRP

Number 21 on your Feedback card

Low Power Operation

Mike Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

While doing a review on the Howes transceiver kits, I found they lacked even the simplest T/R switching—it's done manually with a front-panel-mounted switch. The lack of a sidetone also proved frustrating to me. The kit did have a module for RF sensed sidetone generation, but that required a second speaker; one speaker (or headphone) for the receiver and another for the sidetone. I toyed with the idea of using a pair of stereo headphones—one side for sidetone, the other for receive audio. I trashed this idea based solely on my experience with stereo headphones and amateur receivers.

Stereo headphones have an audio response much too wide for pleasant listening. A 10 kHz beat note can really be appreciated after hearing it through a quality stereo headset. Reducing the audio bandwidth is especially important with a direct conversion receiver.

So, to fix both problems, I built up the circuit shown in Figure 1. It's a combination QSK module with sidetone generator. It also has a reed relay for keying the emitter lead of the driver transistor used in the Howes transmitter. Today's electronic keyers normally use a transistor pulling the key line to ground. This method works very well . . . most of the time. But, the emitter-collector junction, with its 0.7 volt drop, will not pull the key line all the way to ground. This may cause trouble when keying a rig using emitter keying, such as in the Howes transceiver.

Another drawback with the Howes system of T/R control is the ability to key the transmitter without switching the antennas. This could destroy the PA transistor in the transmitter, or cook the receiver. My QSK module prevents this from happening.

The QSK Module

A multi-pole relay does the switching between the receiver and the transmitter. The relay switches antennas, grounds the receiver's front end, and has several contacts left over for other tasks.

The reed relay keys the transmitter while the sidetone is injected into the receiver's audio chain. You can adjust the delay between transmit and receive with a front panel control. This control replaces the manual T/R switch on the transceiver. It's possible to get full QSK, if you don't mind the clicking of the main relay as you key.

In our bells and whistles department, a red LED glows when the module goes into transmit mode. I installed this LED behind the translucent face of the meter. It looks nice and, best of all, you don't have to drill any more holes in the front of the rig.

How It Works

A stable +5 volt reference voltage is supplied by U3, a 7805 regulator. A small load is placed on the 7805 by R15. This helps keep the regulator stable. One section of an LM324 is used to buffer the output of the regulator. In a circuit like this, the use of a buffer for the reference is overkill, but since the amplifier was available, I took advantage of it. The +5 volt reference is used by the delay circuit. Capacitors C6 through C8 are required to ensure stability. The entire QSK module is protected from reverse polarity by D1, a 1N4002 diode.

The QSK module is keyed by grounding the junction of R1 and R2. Normally, this junction is 3 volts. Resistor R3 and C1 help to remove any noise on the key line. Amplifier U1A buffers this key line before sending it out. The output of U1A is normally high. Keying the QSK module pulls the junction of R1 and R2 to ground. The result is a low at U1A's output.

With U1A output sitting high (unkeyed), it goes to three different subcircuits: sidetone generator, delay driver, and transmitter keying. The sidetone generator is a 555 timer (what else?) and is kept off by Q2. This keeps the timer's reset pin held to ground. When the QSK module is keyed, Q2 turns off, allowing the timer's reset pin to go high. The resulting output of the 555 is filtered by R15, R16 and C9. This filter clips off the edges of the square wave to make it easier to listen to. DC blocking is provided by C10. The output level is set by trimmer R17. The resulting 800 Hz tone is fed to the receiver board via the center terminal of the volume control.

The delay circuit takes the high from U1A and compares it to the reference voltage. When the QSK module is unkeyed, U1C outputs a high, charging up C4 via D2. This output is compared against the reference voltage by U1D. As long as the input is higher than the reference Q3 remains off.

Keying the QSK module changes things. U1C turns off, and C4 begins to discharge via R8 and R9, the delay control. When the charge on C4 is lower than the reference on U1D pin 13, it outputs a high turning on Q3, a power MOSFET. The relay then closes and the antennas switch. Diode D4 protects Q3 from the EMF caused by the relay coil's collapse.

Transistor Q4 inverts the output of U1A. With Q4 on, Q1 is turned off. When Q4 goes off, Q1 turns on and keys the rig via the contacts of the reed relay. Transistors Q4 and Q1 follow the keying at the R1, R2 junction. The reed relay provides a direct-to-ground keying for the Howes transmitter.

Construction

Although when first looking at the schematic the QSK module seems complicated, in fact it's really two ICs and some transistors. You could use fewer components, but I think you'll get sloppier operation, too.

This module is built on a piece of copper-clad perf board available from Radio Shack. The circuit is simple, so no PC board is available. If you're so inclined, lay one out if you wish. The relay is mounted on its side using a piece of double-sided tape. Diode D4 is mounted across the coil pins and not on the perf board. I used IC sockets for the LM324 and the 555 timer chip.

I placed the LED inside an LED lens before I glued the combination to the back of the meter's face with a drop of super glue. The lens does little to make the LED brighter, but its flat face makes the glue hold better.

It's best to build this circuit and test as you go. Testing as you go when building on perf board can make troubleshooting easier. The reference voltage source would be the first to go on the perf board, followed by the delay, sidetone and finally the keying components.

After assembly, test the module out before you install it in your transceiver. I left the connections between the antenna, receiver and transmitter up to you. It's simple to do. Using miniature coax, solder directly to the pins on the relay. I pre-assembled the coax before I mounted the QSK module inside the Howes transceiver. The QSK module had to be mounted on the bottom of the chassis. The 50k pot came with the kit and is placed in the front panel hole meant for the T/R switch.

Final Notes

If you have more than $10 in this project, you've spent too much money. The project has junk box priority! You can substitute parts without much concern. You don't have to use a 7805 either. A 78LO05 is fine, any 5 volt regulator would work as well. Why, a zener diode and resistor may work, too.

The 50k delay control is way too low in value for proper use. Capacitor C4 had to be a rather large value to allow enough delay. Why use the 50k pot to begin with? It was a leftover from the Howes transceiver kit. A 470k pot and 22 µF cap for C4 would be a good starting point if you want to experiment.

Although this project began as a fix to the manual T/R switching in the Howes transceiver, there is no reason why you can't use the basic module in your own QRP transceiver. It sure is simple, cheap and packs a lot of features for the money. 73

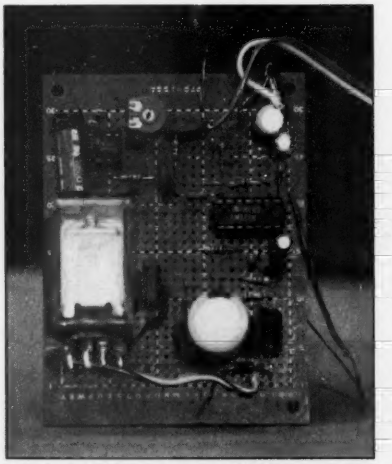

Photo A. The T/R controller is built on a small piece of perf board. The relay is mounted so its contacts are toward the edge of the board.

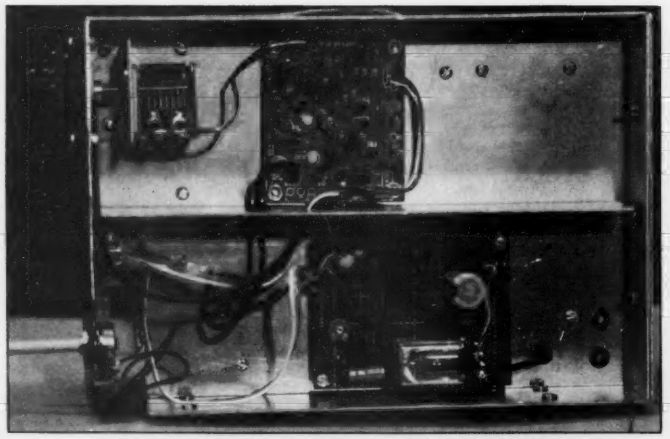

Photo B. Controller inside the bottom of the Howes transceiver.

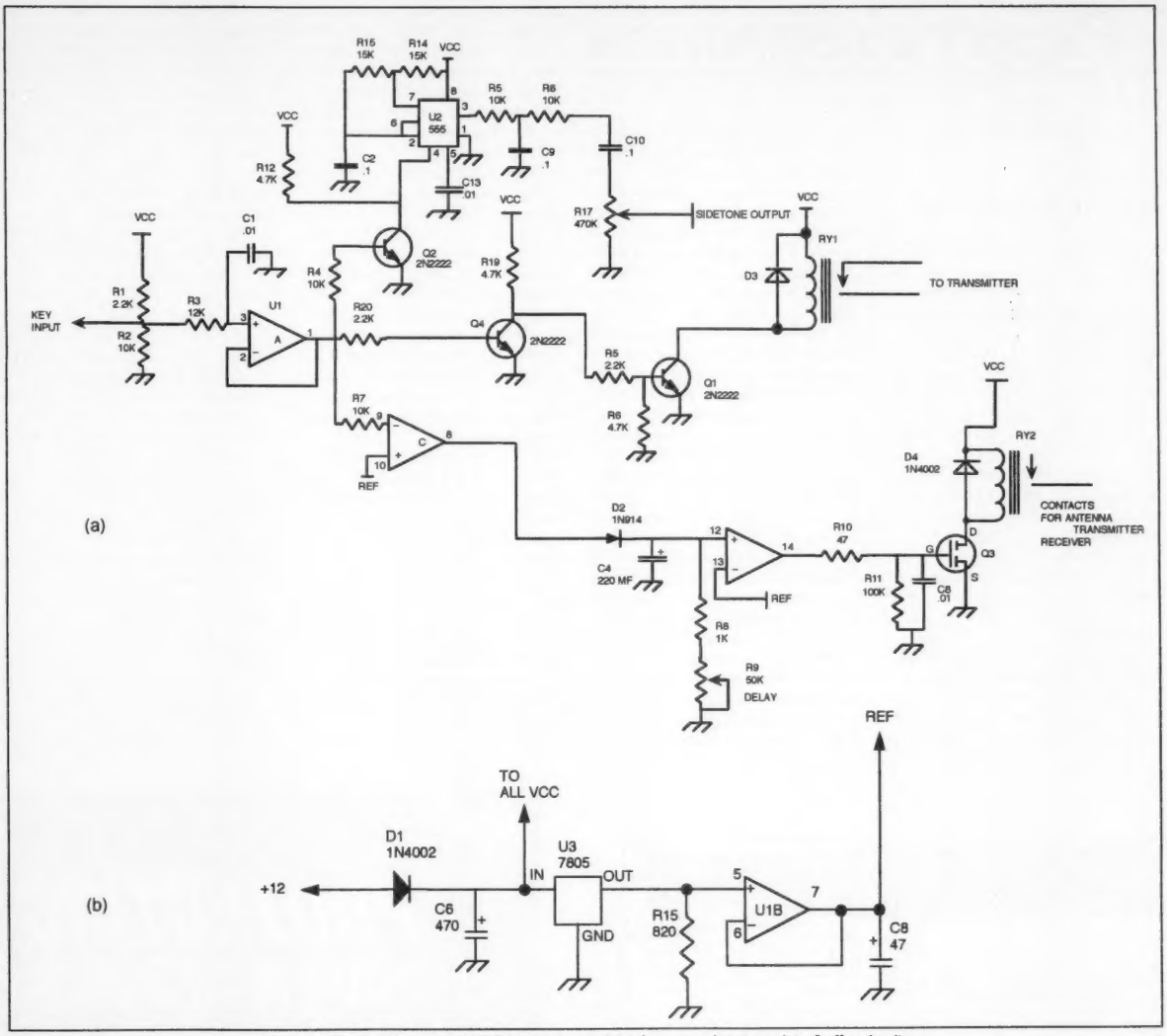

Figure 1. Schematic for the (a) QSK module and (b) reference voltage regulator/buffer circuits.

Number 22 on your Feedback card

PACKET & COMPUTERS

Jeffrey Sloman N1EWO
P.O. Box 636
Franklin IN 46131

What Are We Doing Here?

As you saw in last month's column, I was attacked by the oriental death flu. Well, I am back to about 90% capacity and I'd like to use this month's column to talk a little about JNOS, and some other things. First, last month's column included an example of an AUTOEXEC.NOS file from a working station. It should get you well on the way to a working station with just a little editing. Also included last month was a table describing how to give users permission to access various functions of your JNOS station. In both cases, there are some version-dependent differences—you'll need to sort out what is up with your station by reading error messages and observing behavior.

Catching Up

Many of you may be reading this column for the first time and have no clue what the first paragraph of this column is about. For you, let's take a quick look at what has been going on here for the past few months. Amateur packet radio is usually thought of as AX.25—Amateur X.25. This is a version of the X.25 protocol used in hard-wired networking adapted to use on radio channels. This protocol was developed quite some time ago—as ham radio technology goes—and was made possible for the average amateur by the TAPR TNC1. TAPR is a group of amateurs in Tucson who decided to develop the hardware to make amateur packet radio a reality.

The TNC1 was the first hardware and firmware system that understood AX.25. It was, in effect, a dedicated computer system-which could be connected to a "dumb" terminal and radio. With this equipment, amateurs could communicate via VHF radio circuits for a reasonable cost. What made packet special? Well, unlike ASCII (a form of Radio Teletype, or RTTY), which had been used on these same frequencies in the past, packet had one big advantage-error detection and correction.

With ASCII transmissions, any irregularity in the signal—noise, poor propagation, interfering transmissions—would cause data loss. The result was usually garbled nonsense and the operator would have to ask for a retransmission. Packet, on the other hand, is always error-free from the operator's point of view. This is because packet radio is based on data "packets," technically called frames, which are managed with an error-detection and correction protocol. In a packet radio QSO, each transmission is broken up into these frames and transmitted along with a "checksum"—a number generated by running an algorithm (set of mathematical operations) against the data in the frame. When the receiving station gets the frame, it runs its own, identical checksum. If they match, the frame is undamaged—if not, the protocol offers a way to ask for a retransmission. In any case, the operator never sees anything but perfect data (though it may take some time).

All this protocol stuff happens in that TNC—now a TNC2—and it talks through an RS-232 port to a terminal, today usually a computer running a communications program. This arrangement was much better than the previous digital modes, and it was quickly adopted. It soon became clear that a bunch of hams running stations with dumb terminals or terminal-emulator software was just not going to cut it. If packet radio was going to live up to its potential, something else was needed.

Hank WØRLI decided that some sort of host system was needed. Something that could store and forward messages and bulletins. WØRLI PBBS (Packet Bulletin Board Systems) soon became the de facto standard for the store and forward systems, and networks with PBBSs appeared all over the country. Today, there are many PBBS packages out there. All of them work hard to interoperate, but the standards involved are more of a gentleman's agreement than the law. Still, all things considered, the packet network works very well.

The problem is that PBBS software expects ordinary AX.25 connections and acts as if the connected station is a terminal. There is nothing inherently wrong with this, and this sort of access will be needed for a long time, since many users will only have a dumb terminal available. On the other hand, many hams are running sophisticated computer systems capable of being PBBSs themselves. These users then run a terminal program which turns their powerful system into a dumb terminal—what a waste!

The Other Possibility

There is a system which runs beautifully over amateur radio and takes advantage of the computer in the shack. It is based on an internationally recognized set of standards, and in the right location can let you literally

connect to nearly anywhere in Europe and many other places in the world with 5W. When I say connect, I am talking about real-time keyboard-to-keyboard connections.

This system includes utilities that will allow you to compose mail on your own machine and have it transparently delivered to the addressee. It lets users who cannot run their station full-time get mail automatically in a batch process whenever the machine is available. It also includes a program that allows the error- and trouble-free file transfers of large (500 MB and more) binary files, without monopolizing the frequency, even at 1200 baud.

What is this system? It's called TCP/IP (Transmission Control Protocol/Internet Protocol) and it is available to the radio amateur in the form of KA9Q NOS (Network Operating System). TCP/IP—often called just plain "IP"—is a protocol for communications and a set of utility programs that offer the services discussed above. Phil Karns KA9Q wrote the seminal version of TCP/IP for amateur radio, and his source code is the basis for all of the available versions today—and there are lots!

The other thing to be aware of about TCP/IP is that it is the standard for communications on the Internet. Yes, the Internet—our present information superhighway. This fact has led to the use of the Internet—which goes everywhere—to connect amateurs from all over the world using "wormholes." These are point-to-point connections over the Internet. To get an idea of the practical effect of this situation, imagine a theoretical ham in Bloomington, IN. This is the location of K9IU, an amateur TCP/IP station connected directly to the Internet. From this location, our ham can connect to Hawaii, Australia, California, Chicago, Holland, and Canada by using a low-power VHF radio.

Now, you can do this with a normal packet station, since the NOS package offers a BBS interface for such connections. But if you run some form of NOS, it is possible to directly interact with resources anywhere on the amateur TCP/IP packet radio network.

Getting Started with TCP/IP

So now you know why, here's what we were doing: JNOS. JNOS is a version of KA9Q NOS, modified by Johann WG7J. This version of NOS was chosen for several reasons, among them:

It is widely used and available.
It is feature-rich.
It is stable.
It is still being developed—though Johann has chosen to take a break.
I use it.

To run JNOS, you need the JNOS package. You will find many versions out there and, version 1.07b is the recommended, though not the latest, one. You can get this on the *73* BBS (603-924-9343, 300-2400 baud, 8 data bits, no parity, one stop bit) and many other sources. Check any ham radio BBS that you use—it is most likely there.

You also need a PC, though not anything fancy. An XT will work, an AT is better, a 486 is better yet. You get the idea: the bigger the better. Finally, you need a TNC and a radio. JNOS uses the TNC in "KISS" mode (Keep It Simple, Stupid), so your TNC must have this capability—most do, but check.

The only other thing you'll need is help and patience. The help you can get here and where you live; the patience is up to you. Using JNOS is lots of fun, and it offers much more than the run-of-the-mill packet operation. Keep reading this column as we continue this series.

A Product You Should Consider

There is a product out there that has not gotten the attention it deserves. It is a good idea, is executed well, and is very useful to many hams. The product I am referring to is called the "PC Packet Station."

All in One

The PC Packet Station is a 3/4 PC expansion card with a BayCom 1200 baud packet modem and a 5W two-channel Motorola VHF radio. Plug this board into your PC, load the supplied software, and plug in an antenna—your packet station is on the air. No radio wiring, no TNC wiring, no used-up serial port, and no space taken up in the shack! This may be just what many of you have been looking for. You can also use the unit with TCP/IP by loading the widely available AX25DRV driver for the BayCom modem.

The software supplied is a comprehensive terminal program specifically designed for packet radio. When combined with the PC Packet Station board, the result is a slick, easy-to-install-and-use package—a real solution for many of you.

Another Good Reason To Buy

I don't know about you, but I really like to buy things that are:

Made in the USA.
Obviously a labor of love.
Supporting a US-based startup amateur radio manufacturer.

The PC Packet Station fits all three categories, and deserves your support. To find out more about the PC Packet station, contact:

PKT Electronics, Inc.
2668 Haverstraw Ave.
Dayton, OH 45414
(513) 454-0242 (voice)
(513) 454-0029 (fax)

ATV

Number 23 on your Feedback card

Ham Television

Bill Brown WB8ELK
c/o 73 Magazine
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Peterborough NH 03458

Winterfest

This past January I attended the annual Monterey, California, hamfest (called Winterfest). Sponsored by the Naval Postgraduate School Amateur Radio Club, this event offers a nice flea market stocked full of unique goodies, as well as a great series of inside booths and forums covering just about every special interest facet of ham radio.

This year's ATV exhibit was manned by Doug McKinney KC3RL, Rene KD6OCP and Ian Bible KE4EAC. One of the unique aspects of their display was a live demo of Ian's mobile R/C ATV off-road vehicle.

R/C CarCam

Capable of sending back an exhilarating ground level view of the hamfest while racing up and down the aisles, Ian's R/C carcam proved to be a real-crowd pleaser. The ATV booth was usually quite busy as onlookers watched the high-speed antics of the carcam. The carcam was very popular with the kids as well. Every time I saw the carcam race by, it was followed by an entourage of kids trying their best to catch it. A number of times Ian took the car out to an open area near the flea market and thrilled us all with some very high-speed (about 60 mph) runs across the parking lot.

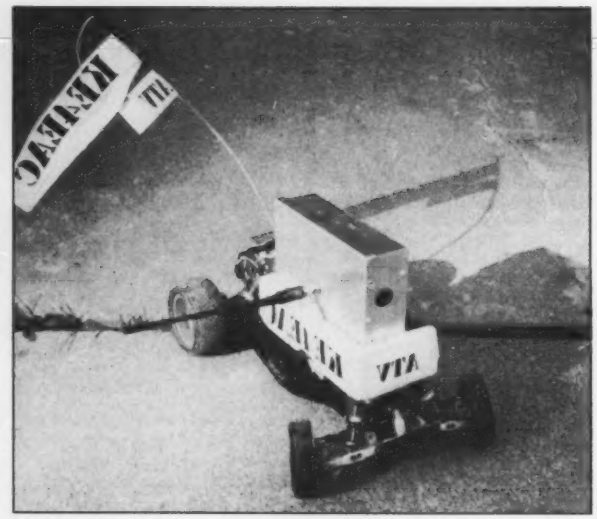


Photo A. The ATV carcam system consists of a R/C off-road vehicle carrying a 1 watt ATV transmitter and camera.

The CarCam System

An avid R/C off-road enthusiast, Ian got the idea that it would be fun to install an ATV system on his R/C car for the hamfest demo. The off-road model he used is made by Team Associated (model RC10) and is powered by a NiCd pack capable of about eight minutes operation.

The ATV system consisted of a Marshall Electronics Micro Miniature b/w camera (model #1206, 380 lines and 0.5 lux) and a 1 watt KPA5 P.C. Electronics transmitter. Packaged in an aluminum box with eight AA-cell batteries and a rubber duck antenna, this made for a very compact package capable of being mounted to the R/C car. The AA batteries usually lasted several hours and Ian carried extra NiCd packs for the car's power system. Since the NiCd packs could be quick-charged in 20 minutes, Ian could keep the car running nearly continually during the hamfest.

To attach the ATV package to the R/C vehicle, Ian cut out a block of styrofoam to fit between the car and the ATV module (see Photo A). He secured everything with nylon straps which held on nicely even during the highest-speed runs.

Using the 75 MHz system that came with the R/C vehicle, Ian could control the car out to about 300 yards while the ATV transmitter was running. He found that there was a lot less interference to his R/C system when using 439.25 MHz instead of 426.25 MHz.

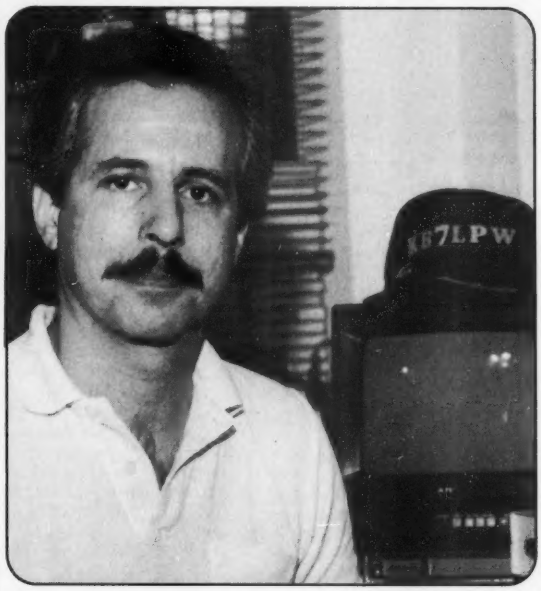
Photo B. Ian Bible KE4EAC can control his R/C off-road ATV vehicle out to nearly 300 yards and reach speeds approaching 65 mph.

A Versatile System

If you plan on making your own R/C carcam, you could use just about any moderate-sized off-road model. Depending on the distance you intend to cover, you could extend the battery life and the weight of the transmitter system by using a lower power transmitter (for example, P.C. Electronics also offers a postage-stamp-size transmitter that puts out 80 milliwatts). Although the R/C carcam system makes for a great hamfest demo, it could be adapted for a number of other interesting uses. This kind of ATV system could be used in robotics and maybe even as a probe for hazardous situations. Imagine being able to send a small R/C vehicle carrying an ATV transmitter into a fire or emergency area.

HAM RADIO & MORE

National Talk Radio Show With Len Winkler, KB7LPW



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ABOVE & BEYOND

VHF And Above Operation

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Converting HF SSB Systems for Microwave Use

This month I will cover an HF-to-VHF transceiver conversion that can serve as a single-sideband IF system for use with microwave converters. Some of us are lucky enough to have a 2 meter multimode rig that can be devoted to the job. However, there is a growing need among those who can't invest heavy bucks into such a package to dedicate it for microwave use. You can purchase a multimode rig for 2 meters, but watch out for the price—it might shock you. That's the reason for this month's topic, a viable alternative to a very pricey VHF multimode rig. I believe that the most economical method to achieve this goal is to convert or modify an existing high frequency SSB radio for use on 2 meters, which is a good choice for microwave IF.

Why don't we use 28 MHz directly for the microwave converters? Well, the main purpose of converting 28 MHz to 145 MHz is that when using a 28 MHz source to drive a microwave converter, the image frequency produced in mixing is not removed by filtering of the microwave products. The bandwidths of most microwave filters are not narrow enough to pass the real signal and remove or attenuate the image signal. By converting 28 MHz to 145 MHz we now have an image product that is offset in frequency by some 300 MHz rather than 60 MHz. The image at 300 MHz is a lot easier to filter out with conventional microwave filters. Another benefit of this conversion is that you have a low-power transceiver that can be used for 2 meter SSB work as a bonus package.

That's the direction we will be going this month: modifying an older SSB solid-state transceiver for 80 to 10 meters, and adapting a few modules to make it into a 2 meter SSB IF system. This conversion project is in response to many letters I have received inquiring about how one can obtain an inexpensive SSB transceiver for microwave use. The project descriptions should give you some ideas on what to look for, especially on a limited budget.

Choosing Parts and Construction Methods

I don't expect you to follow the exact construction and modifications I preformed on the radio I selected. I used the Atlas PC boards because they were readily available and served as an example of one method to reach the goal.

I have several 2 meter SSB transceivers in use at present, but I had lots of fun constructing the HF base SSB system for this example. I've got to let my passion for the workbench be expressed: I love it. The HF PC board I used for this project was damaged and had to be repaired. I had to do that—it was ripe for this project. In any case, that's what I selected for the HF SSB generator portion of the 2 meter SSB transceiver. I hope you put your swap-meet talents on alert for bargains to use surplus material or other low-priced equipment requiring just a modest investment to make the 2 meter SSB system goal reachable.

This description is one of many methods available to build your system. The best selection for an SSB system is a solid-state unit, but a tube-type unit will work, with obvious limitations for portable operation. Typical HF rigs lack FM operation, another possible mode that could be useful for microwave operation. Not having FM should not be a problem as there are so many 2 meter FM HTs available if you are considering FM as a alternate mode to SSB. I feel this limitation is not worth considering as SSB is the prime mode of operation contemplated. Let's get a basic approach and then start modification on my selection, the Atlas R-100. See Figure 1, the block diagram of the system.

Here's a little background on the performance of a similar system constructed by John WB6BKR, a member of the San Diego Microwave Group. John uses the same Atlas base system that I am about to describe. The microwave end of the system is a MA/COM commercial dish and transceiver originally intended for telephone-type service. It required an IF near 2 meters and John built up an SSB transceiver using the same scheme to be described here. The PC boards were part of an Atlas R-100 80 meter to 10 meter receiver. The transmitter, a T-100 Novice type CW and SSB transmitter, was an add-on option, sort of a "buy the option and add it on as you go" type of rig. The transmitter unit is not required in the modification as only the mike audio circuit is needed, along with the receiver PC board and a relay switching R/T voltages.

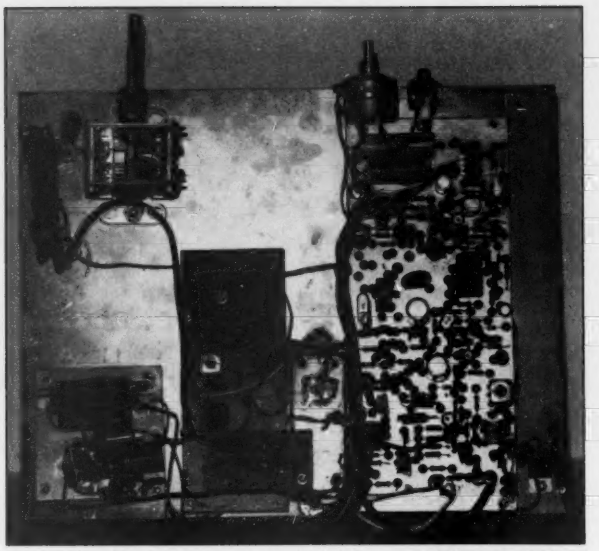

Photo A. The Atlas R-100 receiver constructed from scrap PC boards. VFO and other shield compartments removed for photograph.

Remember, any small similar HF PC board system can be used. The basic components from some other HF commercial device that is small and could be adaptable to converter use can also fill the bill. I suggest you look at the possibility of obtaining one of the Heathkit monobanders, the Atlas or Swan monobanders, the Radio Shack 10 meter transceiver, or some other similar type SSB HF radio, to do the job. I mention monobanders because when these show up at swap meets they do not carry a high price tag. Some are tube-type and demand a lot less in the expense column. That's a big plus for home stations and economy. The solid-state versions can be somewhat more costly, but they are still relatively inexpensive when located at swap meets.

The Modification

In any case, the modification consists of removing or disabling the power amplifier circuitry as only low-level RF is required for transverter operation. Most converters require less than 10 mW of RF for transmit operation. By way of comparison, I have never repaired the defective RF final of my 2 meter SSB HT, a Santec multimode rig that I use for microwave conversion as it's not necessary to have several watts of

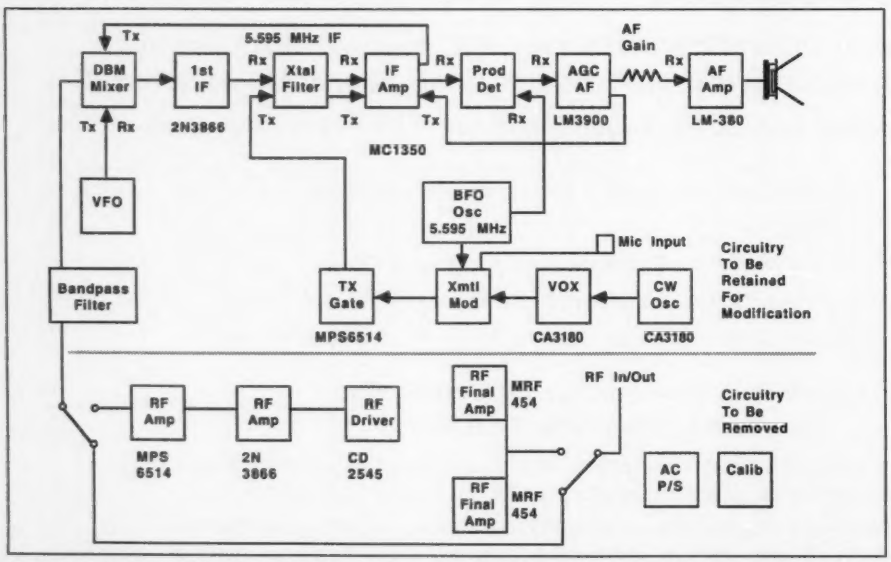

Figure 1. Block diagram of the Atlas RT-100 system. Atlas R/T 100 SSB transceiver circuitry switched from REC to XMT with relay activated by mike PTT switch "T" line grounded in receive and switched to +12V in transmit.

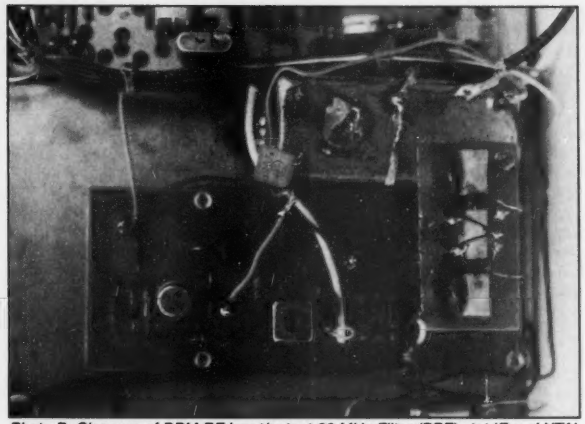

Photo B. Close-up of DBM RF input/output 28 MHz Filter (BPF), 1st IF and XTAL filter at 5.595 MHz. Lead dress not critical—shown for ease of construction.

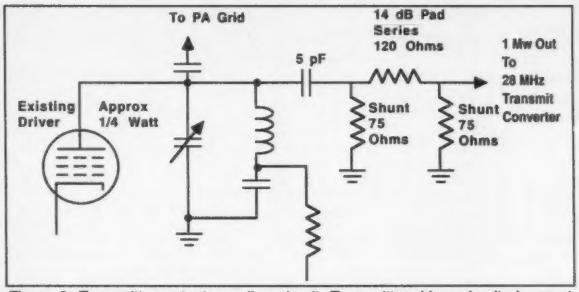

Figure 2. Transmitter output coupling circuit. Transmitter driver circuit shows attenuator attached to tube-type driver to reduce power at driver output to level suitable for Hamtronics transmit converter. Use 2 watt carbon resistors. Keep all leads short.

power in this application. Without the final transistor, this rig puts out about 75 mW and is just right for most microwave IF systems with a 10 dB attenuator.

By the way, I picked my Santec multimode HT up for $50 as a "Basket Case," essentially a case and a bag full of PC boards and components. It did not work at first, but with a lot of troubleshooting and love it is back on the air. Possibly you can do something similar. You just have to keep your eyes open.

Let's get on with the conversion description of the Atlas RT-100 HF SSB/CW transceiver. The beauty of this system is that only the PC board from the basic receiver is required to construct a Single SideBand (SSB) transceiver.

In the case of a tube-type driver circuit, low-level power can be taped off the driver stage if you don't want to remove the final circuitry from operation. See Figure 2 for suitable output coupling circuits for a tube-type rig. The circuit in Figure 2 will not be needed if you build a similar transceiver driver as I have done as the power is limited to a few mW. See Figure 3 for a low-power indicator.

The Atlas Radio used in this modification was part of an R-100 and T-100 80 through 10 meter beginner SSB and CW transceiver—basically a Novice CW rig that had SSB capability. The SSB capability was there when the Novice got his upgrade license and could then use that portion of the radio. It was built to be a "purchase the feature as you upgrade" entry in the amateur market.

The Atlas T-100 came stock with a 5 watt final and could be upgraded to add a 100 watt amplifier into the transmitter chassis, which is remote and alongside the receiver cabinet. In any case, the thing to focus on is obtaining something similar, an HF SSB transceiver that is inexpensive, and mainly solid-state. This fills most of the goals towards an SSB IF system for 2 meters or whatever IF frequency you intend to use.

See Photo A, the basic Atlas R-100 PC board and the system I constructed for 28 MHz SSB. Left behind in this modification was all the band switching (80/10 meters) as it was not required. The transmitter circuitry, save for the mike audio circuit, was constructed in the lower left corner, dead-bug style. See Figure 4 for the mike schematic used in the example. The main receiver PC board contained the second IF, product detector, BFO, AGC and audio amplifier. The BFO, product detector and IF amplifier serve dual purposes and are active in transmit when the audio amp and AGC are de-activated.

The SSB filter was mounted exter-

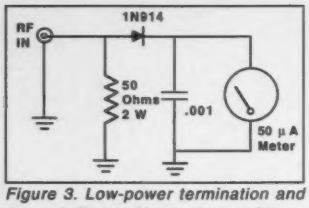

Figure 3. Low-power termination and power indicator. Use carbon resistor—other types might be inductive, causing improper termination of RF.

nally and the first mixer and first IF amplifier were mounted on another PC board. Reconstructing these PC boards made for a very small transceiver. Actually, the reconstruction was necessary because the radio (Atlas R-100) looked like a truck ran over it, and salvaging the PC boards was necessary.

I chose to re-construct the transceiver dead-bug style on a scrap of PC board to better demonstrate the system. I left the shielding off for photographic purposes. In the final version I moved the VFO from the top left corner of the PC board to the middle of the board; Photo A was taken before this was done. In the old VFO spot I placed the Hamtronics 144 MHz to 28 MHz receiving converter. Now, in your conversion you might not be able to obtain the Atlas R-100 PC boards that I used for examples but in most cases the principle is the same. You are looking for circuitry and a filter platform on which to construct your transceiver or a complete HF rig for 28 MHz, and to incorporate the Hamtronics modules for 2 meter operation.

You don't have to tear apart your stand-alone 28 MHz SSB transceiver as it can be converted in place. It's your choice of size and how you want to configure your system. The biggest problem in using a 28 MHz transceiver as it stands is that the high-power output must be attenuated before it can be used with a microwave converter. I operate from batteries and excessive current draw on batteries is detrimental. Why generate high power of 20 to 100 watts only to attenuate it back down to a very low level for injection into a transverter?

Removing or disabling this part of the circuit reduces these problems, and battery current draw is minimized. Just because I re-packaged the system doesn't mean you must; it's a matter of choice. If the re-packaging seems intimidating then keep the radio in stock condition and construct a converter as an external device. The choice is yours: modify or re-construct. I chose to start from scratch from a junked radio because it was available. Use what you can locate.

Looking at the system block diagram of the Atlas R/T-100, it is clear that for transverter operation high power finals are not required. Only about 20 to 50 mW of power are needed in this application. Output power from the mixer circuitry in transmit is in the range of 1 to 10 mW and is quite adequate for most up-converting schemes. This makes drive to the VHF 2 meter mixer quite simple.

Construction

A word of caution before you contemplate ripping apart your SSB radio: Think the process through before removing PC boards and circuitry. I once observed a 10-speed bicycle being torn apart to give it a real spiffy paint job, and not all the parts could be found when the paint job was complete. The bike became a pile of junk. This happened due to lack of planning and documentation of the pieces. Don't let lack of planning happen to you.

If you are thinking that this is too much of a project to attempt, possibly you should construct a portion of the circuitry first and give it a try. If you are unsure of just what to construct, let me suggest a VFO for starters. When it's complete, test it and if all seems OK, move on with the project in a portion of the circuit as you go. Don't look at the entire project as a whole. Keep it in perspective, one stage tied to another, and test as such, stage by stage. In that way you will not be overwhelmed by the entire circuit. As you proceed from one circuit to another, in small steps carefully planned out, you should build up success and confidence as you proceed. Remember: Do not rip out all the circuitry at once but rather move in a predetermined pattern towards a planned goal. When a large circuit is looked at as component modules, the entire scope of any modification becomes much clearer. In most cases the radio can be returned to the original condition by careful planning and labeling of cut leads when disabling circuitry. Keep records and drawings of your mods.

I tested the PC boards in my system in a circuit, module by module. In this way a complicated circuit becomes small chunks of circuitry and easier to test. Check for obvious shorts in DC distribution and apply power when clear. Check the basic unit as a receiver. Start with the audio amplifier and move back towards the IF, then the RF part of the circuit. Don't worry about the transmit circuitry now, get the basic receiver working. Test the IF amplifier and the crystal filter circuitry. If you have a signal generator it can be used prior to construction of the VFO. Use test equipment at your bench to your best advantage by furnishing missing signals to determine just what is not functioning properly.

When you have the receiver operating, start to check out the transmitter circuits. Many of the transmitter circuits are common to the receiver circuit being used in a dual fashion in the Atlas R-100. They are switched by the "T" control line from receiver configuration to transmit configuration with steering diodes and associated coupling circuits. It's a simple and effective scheme, allowing the VFO mixer and IF amplifier to reconfigure the circuit for transmit from receive. In receive, the mixer has the VFO injection and converts the an-

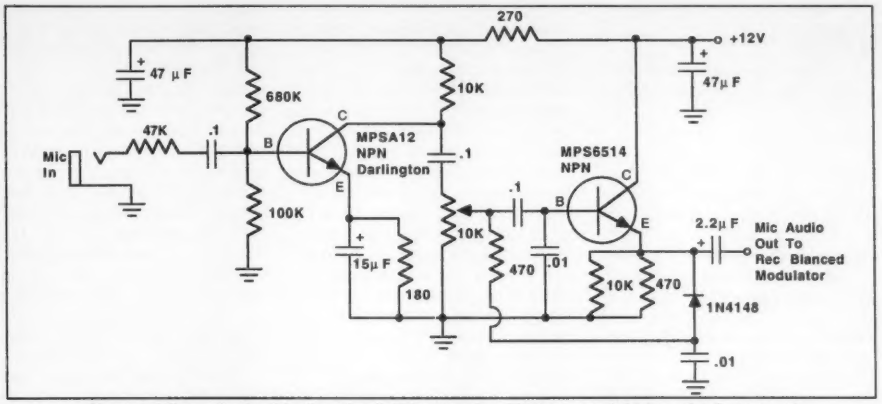

Figure 4. Mike audio circuit for the Atlas R-100 conversion. CW keying and sidetone circuits removed.

tenna-received RF to the IF and on to the detection circuits. In transmit, the mike audio is mixed with the BFO crystal and injected into the input of the IF amplifier. The output is no longer connected to the receiving product detector; it is fed to the filter. The output of the filter is then fed to the front-end mixer, which is bidirectional (the first IF amp isn't used). Voilà! Low-power output (a few mW) to the antenna on transmit.

The nice thing when working with a low-power transmitter circuit such as this is that you can hold the transmit "T" line in transmit for long periods of time without worry about over-dissipating finals (there are none). Power output is, as I stated earlier, 20 to 50 mW.

Observation of output signal can be confirmed with a power meter, SWR bridge, or o-scope. If you don't have an indicator you can make one from a 1/2 watt 50 ohm resistor and a diode connected to a sensitive microamp meter for an indicator. See Figure 3. Whatever type of device you use to test the modified rig at 28 MHz, use a terminating resistor of 50 ohms. Any power rating will do just fine; 1/2 or 1/4 watt is actually an overkill, but here common components work well. You can listen to audio quality on your base station as a monitor. So much for indicators. I have been saving that discussion and a bunch of other items as simple test adjuncts for a VHF bench test equipment column. I won't go into details here but rather save it for that time.

Hamtronics Kit Option

The next part of the system, converting from 28 MHz to 2 meters, 144 MHz, will follow in next month's column. I thought about designing a transmit/receive converter from 10 meters to 2 meters but then I saw the Hamtronics advertisement in *73*—they provide kits ready to go. Why re-invent the wheel? Hamtronics has done all the hard work and provided in kit form just what I was looking for, a Hamtronics XV2 transmit converter and a CA144 receive converter. I had several reasons for making this choice: Hamtronics is an established company with quality kits, and their pricing is very reasonable. My prime goals were low cost and modest labor output on my part, and these kits certainly fill the bill.

The XV2 transmitter kit and the receiver kit CA144-28 were both designed to convert 28 MHz to 144 MHz Xmtr, and 144 MHz to 28 MHz for receive. The transmitter costs $89 and the receiver kit is $49, for a total cost of less than $150, which is quite reasonable. Coupling these kits with the HF SSB transceiver, your modification will complete the package for a 2 meter SSB system for microwave IF use.

You may wonder why I went to the trouble of constructing a 28 MHz system when I already have SSB systems for microwave use and you might question my sanity. Let me assure you that I constructed this working system to demonstrate that it is possible to homebrew with surplus components. I hope this re-generates interest in home-brew construction, as this is not difficult nor expensive.

Well, that's it for this month. Next month I will cover the construction of the Hamtronics converters part of this project for 2 meter SSB operation. As always, I will be glad to answer questions pertaining to this and similar topics. Please send an SASE for a prompt response. 73 Chuck WB6IGP

Number 25 on your Feedback card

ASK KABOOM

Your Tech Answer Man

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Plug and Play?

Before we get to this month's topic, I'd like to discuss a letter I received from a reader named Rick, who gave no call, no last name and no address. He pointed out that, in my January column, my drawing of the transistor model using two diodes was not physically correct, and he sent photocopied pages from a transistor theory book showing that the internal construction of a bipolar transistor is actually like two back-to-back diodes, with the base connection between them.

Before others start complaining about it, please understand that I was not trying to describe the insides of a transistor! Rick is right that my representation is not physically true, but it wasn't intended to be. Rather, I was trying to show what a transistor looks like to external currents *when it is conducting*. The physically correct model makes it awfully hard to imagine how current could ever flow between the emitter and collector without a deep understanding of the "holes and carriers" physics stuff that goes on in the junctions. I was trying to avoid that, and my diagram was correct for its intended purpose. I'm sorry for any confusion that may have caused. Anyway, Rick, whoever you are, thanks for writing; it's good to know we still have knowledgeable hams out there who care about electronics.

AC Adapters

Have you ever wanted to run your walkie, QRP rig or some other small piece of ham gear from the AC line without resorting to an expensive power supply? Or, perhaps you bought something at a hamfest and it needs an AC adapter, but you didn't get it and have no idea of the voltage or polarity. And I'm sure you've seen those boxes of ultra-cheap adapters at the 'fests and drooled over the opportunity to get inexpensive DC power for your stuff. From what I've seen, no device causes more damage to small electronics than the AC adapter! Specifically, the problems occur when the wrong adapter is used. Matching an adapter to a piece of gear may, at first glance, seem trivial, but there's more to it than meets the plug. Let's take a look.

Matchmaker, Matchmaker

Before you even consider plugging the adapter into the gear, check to see how closely the voltages, currents and polarity match. The polarity is a non-negotiable item; if you get it backwards, you are probably gonna cause some serious damage to your device. That's how most gadgets get trashed by adapters, because people assume that a plug which fits means correct polarity, and it just ain't so. In fact, it used to be that most manufacturers were pretty consistent among their models, but even that much "standardization" has disappeared. I've seen Sony products with opposite polarities, although they tend to use different-sized plugs to avoid disaster. Some other companies are not as careful. This is one point you simply must not fail to double-check.

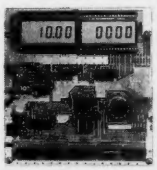
If it's not written on the case, determining the polarity of an AC adapter is as easy as plugging it in and measuring the voltage with your voltmeter. But, sans markings, how can you determine the polarity of your device? Sometimes, the only way is to open it up and follow the leads back to the board. Almost certainly, you'll come to an electrolytic capacitor, and you can read the polarity from its markings. As usual, plus goes to plus and minus to minus. If you can't find one directly connected to the power input, take a look at the other electrolytics. All, or nearly all, of them will have the same side going to ground, which usually is the largest trace on the board, and will nearly always be connected to any shields or IF cans. Most likely it'll be negative, although there are a few positive-ground devices out there, especially old ones. Whichever side goes to ground is the same polarity as the incoming power's connection to ground. I've used this polarity-determining technique numerous times, and it has never failed me. One more thing: Some adapters output AC instead of DC, and you must never try to use them on a normal, DC-operated device or you'll probably ruin it. Conversely, an AC-output adapter must be used on an AC-input gadget. Many phone answerers use AC input and perform the AC-to-DC conversion inside, so they can derive both positive and negative voltages for their circuits.

Ideally, the adapter's voltage should be the same as that required by the device; a 6-volt radio should have a 6-volt adapter. But, is there really such a thing? Usually, no. Most equipment is internally voltage-regulated, and very few adapters have any regulators in them. A 6-volt adapter may indeed provide about 6 volts *at its rated current capacity*, but might measure 9 or 10 volts with a much lighter load. The thing to remember here is that most equipment expects this; that's the reason for the internal voltage regulators. They do that for two reasons: Unregulated adapters are very cheap, and the use of internal regulation lets them get the most from a set of batteries.

Here's why: Let's say you have a 6-volt circuit, and it won't run properly on less than 5 volts. If you run it on 4 AA cells, that'll give you 6 volts when the batteries are new, and all will be fine. As the batteries run down, the voltage will begin to approach the 5-volt cutoff level. When each cell is at 1.25 volts, the circuit will begin to malfunction. But, at 1.25 volts, those cells have significant energy left! Why waste it? If you use 6 cells, you'll start at 9 volts, but you won't get down to 5 until those things are really *dead*. Proportionally, the batteries will last a great deal longer. There are other issues involved, such as the difference between using a linear regulator (common and cheap but wasteful of energy) and a switching regulator (more expensive but much more efficient), and how close the regulator's input and output voltages can get before the regulation fails.

The upshot of all this is that most AC adapters have widely varying output voltages, and it behooves you to take a look at the current requirements of your device. If you use an 800-mA adapter to power a 100-mA device, chances are the adapter will be giving you much higher voltage than its ratings specify. Is that good or bad?

It can work for or against you. If you want to power a 9-volt, 100-mA device and you only have a 7.5-volt, 500-mA adapter, you may just find that it all works out fine, thanks to the adapter's voltage being higher at the lighter load. If, though, you want to power a 6-volt, 100-mA device with a 6-volt, 800-mA adapter, you might be getting more voltage than you want, despite the identical voltage ratings. In that case, take a look at whether the device has internal regulation; the higher input voltage may not matter, as long as the extra dissipation doesn't over-



heat the regulator, and the incoming voltage isn't at or above the voltage ratings of any electrolytics on the unregulated side.

Finally, I've seen plenty of adapters that didn't actually live up to their ratings. I remember some 9- and 12-volt adapters which were supposed to deliver 500 mA. Above about 400 mA, the voltage dropped well below the ratings! The only way to know for sure is to measure the voltage while the adapter is actually powering the device.

By the way, the usual result of overstressing an AC adapter is hum in the equipment, due to the adapter's filter capacitors getting heavily drained between AC cycles. When stressed, full-wave-rectified adapters will do better than half-wave units, but even they give up eventually. Everything has limits.

A Good Fit

Obviously, if you want to be able to plug the adapter into the gadget, the plug must match the socket. Although various kinds of plugs are used, the two most common ones are the earphone-type 1/8" and the coaxial. The coaxial dominates the field, and, unfortunately, there are lots of different sizes of them! Due to their structure, there's an inner diameter to worry about, as well as the outer one. You might think that, as long as the thing fits into the hole, all will be well. That's often true, but not always. Two problems can arise: First, the center pin on the jack may not make contact if the plug's inner diameter is too big. The plug fits in fine, but the darned thing just won't work. Or, it'll work if you push on one side of the plug, but when you let go it dies. Second, if the plug's outer diameter is too small, it may not push hard enough against the jack's spring switch. That can have serious consequences, especially if the equipment also uses batteries which get disconnected when you insert the adapter's plug. If the spring switch doesn't open, the adapter may send power to those batteries. If they're non-rechargeable types, you could have a leaky, caustic mess with which to contend. To avoid that problem, I always check for voltage on the battery contacts while I wiggle the adapter's plug around. The voltage should read zero unless the equipment has a charging circuit for NiCds.

The length of the coaxial plugs varies, too. I haven't found it to make too much difference, though, when the plug was too long. If part of the plug hangs out, just be careful not to cause a short between the exposed sleeve and anything else, particularly in the car. If the sleeve's polarity is positive and you short it to something metal on the car, which is negative, you're looking for trouble. If the plug is too short, it may work fine, but you might run into the problem I described above, in which the jack's spring switch doesn't get properly contacted.

Finally, some manufacturers use non-standard plugs and jacks. Sometimes it's intentional, sometimes not. For instance, the ICOM IC-2iA uses an odd variation on the coaxial theme in which the center pin is in the plug instead of the jack; only their plug will fit. And, my Yaesu FT-530 uses what looks like a standard jack, but I haven't been able to find anything, anywhere, that fits it, because its outer diameter is just a little too small.

Other Issues

Sometimes, you seem to have enough current capacity, but you still experience hum, especially in a receiver. You might just need some extra filtering, but the problem also can be caused by a rather obscure phenomenon known as "re-radiation." What happens is that incoming signals, and sometimes the radio's own oscillators, get into the adapter via the AC line or the DC wires. They get rectified in the adapter's diodes, and then they get re-radiated back out the DC wires, where they are picked up by the receiver. The result is that the signals get modulated by the 60-Hz line frequency with each zero cross of the diodes, and you hear it as hum. Many adapters have 0.1 or 0.01 µF caps across the diodes, but sometimes it just doesn't work. It's a difficult problem to cure, and I've experienced it many times with miniature TV sets, where it shows up as a small hum bar riding up the screen. By the way, direct-conversion receivers are so prone to picking this stuff up that most are extremely unsuitable for use with adapters. Battery operation, of course, does away with the problem.

If you try to operate an HT on an adapter, you may run into something similar, wherein your transmissions have hum on them, even though you've got plenty of current capacity. It's your own RF that's getting into the adapter. Sometimes you can cure it with a toroid on the DC wires, sometimes you can't.

Finally, here's a trick you can use when you want to operate something which has a normal current drain within the adapter's specs, but which has momentary demands the adapter can't provide. I ran into that when I tried to rig up an adapter for a little 8-mm video recorder that took several times its normal current for just a moment whenever the eject button was pressed. That caused the adapter's voltage to drop low enough to shut the recorder down. I put a 9600 µF cap across the adapter's output lines, and it stored enough current to prop the whole thing up for the fraction of a second that was required.

Well, I told you there was more to AC adapters than just plug and play! See you all next month. 73 de KB1UM.

73 INTERNATIONAL

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N. Swanzey NH 03431

Notes from FN42

Well, my computer seems to be fixed (I hope). It was acting flaky in more than one way so I thought it might have something to do with the BIOS chip. I removed that and then placed it back in the socket. That seems to have fixed the problem. I guess the chip had been in the socket for so long that the pins got a little corroded.

We have a new Hambassador stepping into the light. Bill Meara N2CQR/HI8, who has sent several newsworthy letters from the Dominican Republic, has asked to become its Hambassador. From the letters he has provided I know that he will make an excellent Hambassador. Welcome aboard, Bill! We look forward to more news from DR.

I received a copy of a letter to Wayne from Dean Hale KF7CR, who commented on a letter to Wayne from Nat V. in Bangalore, India. Dean travels to India regularly and has already sent a letter to Nat so that they might meet. Doesn't that sound like fun! Dean advises that if we are to travel to India, be prepared. India has its share of eye-openers. International travelers need to accept that they aren't in total control of the situation. They are a guest in the host country. Flexibility and patience are important qualities.

Most travel literature is full of glossy pictures and romanticized info. For the business traveler, he recommends the All Asia Guide *published by the Far East Asia Economic Review. He also recommends* India, A Travel Survival Kit *by Lonely Planet Publications. The latter is written by two Englishmen and a Nepalese. A good bookstore will stock either book. The classic* Freedom at Midnight *by Larry Collins and Dominique Lapierre gives a good sense of contemporary Indian history . . . and a peek into the Indian mind.*

If any of our readers are interested in travel to India, Dean will be glad to be a resource. Feel free to call him at work (503-687-2202) or at home (503-683-2985). Tell him that 73 *sent you.*

Congratulations to Woodson Gannaway (Canary Islands' Hambassador) and his wife on the arrival of their first child, Layli Rose Tahirih, born October 27. One of Woodson's neighbors calls her "nino todo terreno," which translates to "four-wheel-drive kid." She goes everywhere with Woodson, so the neighbor has a point!

Now, on to some great news from the world of ham radio. 73, Arnie N1BAC.

Roundup

Russia The "Russian Robinson Club" was created in early 1993 and is interested in the world islands program—Islands On The Air (IOTA). It has supported more than 10 island Arctic DXpeditions in 1993, two of which are new IOTAs: 4K2RRC (EU 019); 4K3RRC (EU 082); 4K4RRC (AS 005); 4K5RRC (AS 025); 4K3GW (EU 161); 4K3WQ (EU 162); 4K3/RW3GW (EU 082); 4K3/RA1ZA; 4K3/RA1WQ; UW1ZZ/A (EU 082); UW1ZZ/A (EU 162); and 4K4DV (AS 029). During this year, the Russian island national diploma program (RRA) has been developed like the national island programs of Italy (IIA), Spain (IDEA), France (DIFM), Portugal (DIP), and Polska (SP IOTA A). Competitors in this program have received more than 120 diplomas. We greatly hope that interest in the Russian national island program (RRA) will be increased every year.

RRC publishes a magazine-report every quarter which gives information about members of the club, the last island, polar and sea expeditions, IOTA News, and provides a databank of Russian island stations, Antarctic stations (4K1), and much more.

Like most DX organizations, we need your support so that our program can continue. We would like to thank you in advance if you could donate anything (money, equipment, etc.) to our cause. All sponsors will receive, free-of-charge, our magazine-report, "Russian Robinson News."

RRC invites all interested hams from different countries of the world to arrange joint expeditions to the islands of Russia. The RRC can help to arrange any visit to any island of Russia and to settle all organization problems. We wait for your suggestions!

Please communicate with our headquarters: RRC, PO Box 3, 398000, Lipetsk, Russia; NSI, Ltd. (RRC), 429 South 321 St., Place # E 10, Federal Way, WA 98003, USA; I1HYW (RRC), Gianni Varetto, PO Box 1, 10060, Pancalieri, (Torino), Italy. Our E-Mail: victor @ stack. serpukhov. su.; Packet: UV3DIN @ W2XO.#WPA.PA.USA. NOAM.

Best Robinson wishes from RW3GW, V. Sushkov.

India The All India Amateur Radio Convention for 1994 will be held in Bangalore April 9-10. This event is called "Hamvention-94." It is sponsored by the National Institute of Amateur Radio and hosted by the Institution of Engineers. The venue is also the Institution of Engineers (Karnataka State Centre), Bangalore.

The theme of the Hamvention is "Ham Radio—A Global Fraternity." It will focus on various aspects of this unique hobby. An exhibition of instruments relating to the hobby, HAMPEX-94 (a stamp exhibition on related subjects) and a Ham-Esperanto meet are planned, along with other usual presentation sessions. Delegates from India and abroad are invited to participate.

For a free brochure and registration forms, write to: Nagesh Upadhyaya VU2NUD, General Convenor, PO Box 1129, Bangalore 560 011, India.

ISRAEL

Ron Gang 4X1MK
Kibbutz Urim
D. Negev 85530
Israel

4X1RU HF-VHF Gateway Going QRT For the past six years, Jim Stone 4X1RU has been running an HF-VHF Packet Radio Gateway. He has dedicated his HF transceiver, amplifier, and beam antenna to this end, and spends about three hours of his time daily keeping everything orderly and running smoothly. For us in 4X-Land, his station is the main junction for all messages and bulletins to and from outside the country. We daily check into one of the four BBSs on 2 metres, and get a list of about 60 new bulletins from all over the world, as well as sending and receiving our own personal mail. All this goes through 4X1RU, and without his efforts, VHF-UHF packet radio in Israel would be pretty boring.

However, it turns out that most of the hams benefiting from Jim's efforts are outside of Israel. Because of the strategic position of Israel between three continents, as well as the peculiarities of 20 metre propagation, much of the traffic to and between Europe passes through 4X1RU on 20 metres. Jim points out that the Pyrenees mountain range acts as a barrier, and he is the main link between Spain and the rest of Europe. 4X1RU says that there are difficulties in the European UHF backbone packet network, and as a result much of the traffic is routed through him. In the past, because of the U.S. FCC rulings about third-party traffic, messages for Europe from the States could be addressed only via Israel, with whom a third-party traffic agreement existed.

Anyone who has hooked up his TNC and computer to an HF rig and watched the packet traffic on 14.107 MHz wonders how any serious messages can move at all there on 20 metres. At 300 bps, a quarter of the speed on VHF, the problem is compounded by the abundance of QRM, and it seems to take forever for a paragraph to be transferred. Nonetheless, 4X1RU moves an average of *one megabyte* a day of messages and bulletins on the frequency.

Jim will now be able to participate in other amateur radio activities (like talking to his friends around the world on HF SSB) and be able to communicate on VHF, which is jammed all the time by the BBS running on VHF. After a "vacation" from all this activity, Jim hopes to investigate activities such a PACTOR and CLOVER.

Thanks, Jim, for all the years of service. Your act is indeed a hard one to follow. Be seeing you on the bands!

VHF-UHF Link to Eilat The trusty team of 4X1OM, 4Z5AY, 4X6PH, 4X6WP, and 4X6ZH installed the first stage of the link bringing to Israel's southernmost point reliable ham communications with the rest of the country. Installed at Shaharut, overlooking the Arava highway from about 50 kms. north of Eilat, the link is tied into the 145.325 Yatir repeater, which covers from the Tel-Aviv area down to the Central Negev. The link relays what is heard on 145.325 to 434.500 MHz, and if 145.325 is quiet, then a signal transmitted on 435.500 will be relayed to the input of the Yatir (in the center of Israel) repeater to be heard on its output. A UHF yagi points down the Arava Road to Eilat and the VHF yagi beams north 160 kms to the Yatir repeater. A 91.5 Hz CTCSS subaudible tone is necessary on both ends of the system.

As these lines are being written, the task of completing the rest of the VHF-UHF-VHF link with Eilat has been completed. *It works!* The link's backbone, located in Shaharut, uses the UHF simplex frequency of 433.300, working into a VHF transceiver in Eilat on one end and the Yatir R13 VHF repeater in the hills north of Beer-Sheva on the other side. In Eilat, you may work using a handie operating on R12 (145.300—offset, as with a standard VHF repeater). You will not hear a squelch tail when you leave the PTT, as it is not acting as a VHF repeater but, rather, is relaying the signal to UHF. The frequency split is just for operating convenience. It can be used as a repeater in Eilat, though, if you use a dual-band rig, transmit on 144.700 and listen on 433.300. And, driving along the Arava highway north of Eilat, you will be linked into both Eilat VHF and the Yatir repeater by working simplex on 433.300. In all cases, a PL tone of 91.5 Hz must be used.

Now all you need is a 2 metre handie-talkie while basking in the sun at this Red Sea resort town and you're in touch with the centre of the country. It was pointed out that this is a true pioneering triumph of ham radio in Israel as there is actually no commercial service at any price that will presently allow you, in Eilat, the same range of hand-held or mobile communications. Hats off to our IARC repeater crew for their imagination, hard work, and pulling off of this terrific job!

MONACO

Daniel Plett 3A2LZ
B.P. 349
MC 98007
Monaco

Monaco has had its share of amateur radio visitors this past month. DK6AS paid us another visit, operating from his hotel room. Another ham came from the UK to operate the CQWW CW contest. Unfortunately, he had equipment and health problems and had to return home before the contest even began.

One visitor who is legal is F9UW. He has been operating mobile/portable

Continued on page 90

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73 INTERNATIONAL

Continued from page 88

from here for years, is fully legal, and also QSLs.

On the subject of visiting hams, not all hams claiming to be from the Principality are actually operating from here. One case in point is 3A2CC. We have been receiving many cards at the A.R.M. for this station. The claimed contacts are mainly for August 1993. This callsign has never been issued by Monaco officials and has never been heard here. If you contacted this station . . . sorry, it doesn't count for anything.

Pirates show up fairly regularly. My own callsign was pirated, especially on 15 meter CW during 1989. All current licensees are listed in most callbooks. The next series of licenses will be in the 3A2M? series.

Congratulations to a couple of Monaco hams. One of them received a U.S. Extra Class license and another, 3A2LU, has qualified for the Worked All States (WAS) Award. To my knowledge this is the first one issued to a Monaco ham.

Finally, the 3A CW group has been issued the callsign 3A2CW. Hopefully this callsign will be appearing on the air soon.

PEOPLE'S REPUBLIC OF CHINA

Rick Niu, Chief Op., BY1QH
Room 316 Building 25
Tsinghua University
Beijing 100084
People's Republic of China

Sorry Es Happy Our apology for the delay in issuing this 17th issue because of two busy weeks with the satellite ground station. Thank goodness we are not too late to deliver our cordial Season's Greetings: We all wish you and your family a Merry Christmas and Happy New Year 1994!

Silent Night A Christmas party was held by TUARC on the evening of November 18, 1993, in a nicely decorated bar near Tsinghua University. All of the club members and many of our Chinese and foreign ham pals took part. A double-layer cake with the sign "HAM 1993" on it was ordered and a BT2000BJ videotape produced by the Worldwide Television News was shown.

China on OSCARS First off, our sincere gratitude goes to John KD2BD for his popular *SpaceNews* (29-Nov.-1993), where our effort to get BY on OSCAR 13 was well-mentioned. We are happy to report that, as of now, all the antenna system and proper connections with the Yaesu V/UHF transceiver have been set up and working. However, nothing has been heard on the SSB when the bird, according to InstantTrack, is overhead. Several packet bulletins regarding a solar eclipse that has stood in the way of normal AO-13 operation have been noted but there might be something else that went wrong. TUARC will appreciate *your* instructions if you have had any experience with the OSCAR satellites or you are a regular user of AO-13. Any reference books would be welcome.

TNX Marconi If you have been carefully searching around 30, 40 and 80 meters lately, you might have come up with BY1QH on CW! Yes—Rick, Sean and our dear old friend Dieter DJ7BU are fairly active on the low bands. Keep listening and we won't let you down: 1430-1600 and 2230-2330 UTC. QSL via the *Callbook*.

First BY2 BY2AA, the first and currently the only station in Region 2, is located at the Sports Commission of Heilongjiang Province in Harbin, Northeast China. Equipped with a TS-180S and a TS-520D, the club started to work the world on SSB and CW on May 3, 1993. Two operators are known to be active: Mr. Li Feng, BZ2LF and Ms. Li Ruqin. QSL via PO Box 89, Harbin, Heilongjiang Province 150001, China.

BA Net They are not a large community, but they are heard every day. This best describes what the BA hams are doing. Every Sunday around 0000 UTC, thousands of Chinese SWLs lock their frequency on 14180 kHz—the BA Net—listening for the most noted 20-odd Chinese hams. What's more, a 2 meter net is "triggered" as well, both in Beijing and Shanghai, when the clock hand points to 8:30 p.m. local time.

The BY2-3 List By July 5, 1993, the following 11 stations (shown alphabetically) have been registered in Regions 2 and 3:

(Call-QSL info) BY2AA-PO Box 89, Harbin, Heilongjiang Province 150001; BY3AA-PO Box 7, Tianjin 300040; BY3AB-PO Box 7, Tianjin 300040; BY3AC-PO Box 7, Tianjin 300040; BY3AD-PO Box 7, Tianjin 300040; BY3AE-PO Box 61, Tianjin 300270; BY3AF-PO Box 7, Tianjin 300040; BY3AG-PO Box 7, Tianjin 300040; BY3AH-PO Box 7, Tianjin 300040; BY3AI-PO Box 551, Tanggu, Tianjin 300452; BY3CC-PO Box 2, Tianjin 300020.

Who's Who at BY1QH Sean, a second-year E.E. student, is one of the youngest but most zealous members of TUARC. After his first meeting with Rick BZ1QL, in November 1992, the open-minded, smart boy quickly became hooked on the hobby, and has been very much involved in almost all of the club activities since. "What a terrific relaxation, working on the radio while forgetting about the pressure from schooling!" Crazy about constructing antennas, Sean is also starting to teach himself CW through the SuperMorse program, and may be heard on the low bands from time to time during the winter season. Acting as a Public Relations Group member, he not only does a super job as BZ1LUV, but also gets the hang of his university subjects very well. "We are always learning, both about the radio and about the life, especially about getting along with various kinds of people. TUARC has taught me a lot of things, and I am very lucky to be in this club and know these guys."

Thanks! Our hearty appreciation this time goes to BZ1AA Tong, BZ1HAM Chen, DJ7BU Dieter, EA4AD Jesus, GW3GJQ Roy, K6DGW Fred, K8OQL Jerry, KA3BMS Hank, KD2BD John, KO4XM Bob, N1BAC Arnie, N5VGC Presley, OE2CAL Walter, SM5BDV Lars, VE7CIZ George, VK5ADD Donald, W5KSI Angelo, ZL1KG John, ZL2MAX Max, and especially, Mitsuo JA5TX for his wonderful Pactor BBS service and Bob NØARY for his state-of-the-art packet-Internet gateway.

TUARC can be reached via any of the following paths: packet—BY1QH @ JA5TX.JPN.AS; Internet—contact Bob, gateway_request@Arasmith.com. For more info, airmail: Rick Niu, Public Relations Manager TUARC, Room 316 Building 25, Tsinghua University, Beijing 100084, People's Republic of China. *[Packet relayed by KE7XO]*

Photo A: QSL card from the Special Event Station at Taejon EXPO '93.

REPUBLIC OF KOREA

Byong-joo Cho HL5AP
Room 401 CQ Building
157-7 Kwangan-2Dong, Nam-Ku
Pusan 608-102
Korea

Let me offer all my sincerest congratulations upon the arrival of the New Year.

I am happy to say that amateur radio station 6K93XPO at the 1993 Taejon International Exposition was a great success. I served as a volunteer operator from August 1 to 31, and it was very enjoyable. I am sending along the QSL card and a copy of the certificate for your use. I am also happy to announce that the EXPO Award has been extended one year to December 31, 1994.

The Taejon '93 EXPO Award may be earned by contacting and confirming contact with 6K93XPO and any other HL QSO made after April 1, 1991. Yes, it only requires two QSOs. The award is also awarded to SWLs. Over 10,000 certificates have been printed. Send the two QSL cards and eight IRCs to: Award Desk, KARL, PO Box 162, C.P.O. Seoul, 100-601, Korea; Tel.: 02-817-7493; Fax: 02-817-7494. Apply until December 31, 1994.

From June to November 1993 I operated with a special callsign, HL93AP, and made contacts with 1400 DX stations and 80 DXCC countries. If you were one of those stations, please QSL to the address above.

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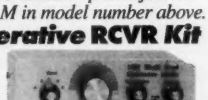

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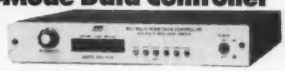

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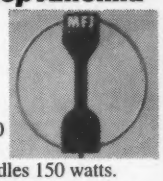

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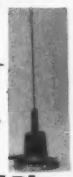

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NEVER SAY DIE

Continued from page 4

tune with the times. They have yet to issue the first American patent in the cold fusion field. Tsk.

Why Stop at Digital?

Digital is good. It's all zeros and ones, marks and spaces, yeses and nos. It's also cumbersome as all hell. It takes eight bits of ASCII code to communicate one lousy letter. I don't know how good you are at counting by twos, but in the digital world you only need two fingers to count. It takes a little getting used to. Why do we need eight bits? Well, if we used one bit we'd get two choices. With two bits we have four. Three bits gives us eight possible combinations. So, where we want to be able to communicate 26 upper case letters, 26 more lower case, 10 numbers, and a bunch of punctuation marks and special characters, we're out to eight bits. That gives us 256 combinations.

Some of the early DEC minicomputers made do with six-bit code, but this only provided 64 combinations, so it slowed them way down when they were used for word processing.

The old Teletype code only had five bits, so we were stuck with only 32 combinations. Maybe you noticed that telegrams were all upper shift letters. The Teletype keyboard had the 26 letters in the lower shift and the numbers in the upper shift, along with most of the punctuation. One key put you in the upper shift. Another was a carriage return, and so on.

Okay, enough about history, now we're going way out into left field. Are you ready for a stretch? One of our problems today has to do with the slowness of communications. We're up around 9,600 baud for much of our landline stuff, and that beats the heck out of the 60 words per minute Teletype speed we started with, and the 100 words per minute we graduated into. Bauds? Bits? When we use ASCII we send our characters in eight-bit groups, plus a start bit, a stop bit, and a parity bit. That's 11 bits for sending one letter or number . . . a byte.

Do I have to explain that parity bit? That's in there to tell you when something somewhere in the system is screwed up. Your computer adds up all the bits in one byte and checks to see if the number is odd or even. If you decide on even parity, it adds a bit to any odd bit number. Thus, if the computer getting the data runs across a byte with an odd number of bits it lights up tilt, telling you that something is amiss.

So, at 9,600 baud we're actually getting about 872 characters a second. Divide by six to convert that into words and you're throughputting about 145 words per second. That's faster than most of us can read. That's over 8,700 words per minute.

It's too slow. We can do better than that. Yes, I know there are some dohinkies that can boost that to 14,400 baud, but it ain't easy. Or cheap.

Trigital?

Now let's just suppose that instead of sending just zeros and ones, that we drive the engineers totally bonkers by sending ones, twos and threes. Our frequency shift keying will then have three frequencies instead of two. Right away that gives us seven combinations instead of two. 1, 2, 3, 1-2, 1-3, 2-3, 1-2-3. If two choices gives us digital, then three should be trigital, right?

With digital and two bits we have four possible combinations. With trigital we have 49. With three bits we have 343 combinations . . . more than enough to handle just about anything in the way of special characters. So we've reduced the number of bits from eight to three for the same throughput. That's 2.7 times the speed with the same number of bits. That's like sending at 25,600 baud.

Now, before you get too excited over this I want to take back one of those combinations and use it just as a start bit. I'd like to use the 1-2-3 combination for this. This will then act as a reference for the three tones. This takes us down to six possible combinations we can use for our bits instead of seven. Three bits will provide us with 216 combinations, which is more than enough to take care of upper and lower case letters, the 10 numbers, lots of punctuation, and plenty of special characters such as dollar and yen signs, brackets, etc.

I'm not done yet. Let's suppose we want to speed things up a little. See where I'm heading? No? Okay, I'll explain. Let's say that we use three bits for most of the ASCII code combinations. That's fine if we don't mind spelling out even the most often used words. But, if we send four bits we'll have 1,296 combinations and thus be able to communicate 1,296 of the most often used words by just adding one bit. This will cover a surprising amount of our normal communications. We could be nasty about it and lean toward shortening words like "communication" to one character, as well as our more often used shorter words.

Hey, we're dealing with computers here, so we can make 'em do almost anything we want, building the complexity into a cheap chip . . . so let's consider going out even one more bit, so we'll have a larger dictionary. Now we're out to 7,776 possible combinations. That's a pretty good-sized dictionary, one large enough so we aren't going to have to spell many words out.

If your computer gets a three-bit "word" it'll translate it into a single character. If it gets four bits it produces one of the next 1,296 words. Five bits opens us to another 7,776 words, and we're still beating the heck out of slowpoke digital. Now we're covered for over 99% of the words used in normal communications.

It wouldn't be very difficult to specify at the beginning of a message if a special dictionary is going to be used. In this way we could have one for doctors, another for lawyers, engineers, computer tweaks, and so on. Even one for hams with all the Q-codes built right in.

Wait, there's more. If we want to have secure communications we can just shuffle those bits a little and the words coming out will be gibberish, unless you have the key.

I'm not done yet. Next, let's suppose that you're in communications with someone who doesn't know English. Like Japanese, for instance. No, most of them know English. Make it Chinese or Arabic. How are we going to do this the easy way? No strain. When you are busy typing in your message your computer will be checking each word as you type for multiple meanings. Then, when you're done, in addition to your normal spelling check, it'll stop at each word with a multiple meaning and ask which meaning you have in mind. The dictionary it uses for this will assign bit groups to concepts instead of just words. I'll cheat on this and add a sixth bit, giving us a 46,600 concept dictionary. That ought to hold us for most communications. We can afford to be a little slower on our throughput when we're providing an automatic translation into any language in the world. We'll still run circles around 9,600 baud ASCII.

"Okay, enough about history, now we're going way out into left field. Are you ready for a stretch? "

With throughput like this we'd be able to transmit for a second or two and send whole stories. It would take around one and a half seconds for me to send a 16-page booklet. The story of my recent trip to Hawaii for the cold fusion conference, plus scuba diving on all six major islands, would take maybe 15 seconds to zip through. Of course you might prefer to not be burdened with reading and just want a signal and weather report. I can do that in a millisecond and be on to more fruitful contacts.

I thought you might enjoy the concept, even though I realize that no one will probably bother to make it happen. Even though someone could easily get disgustingly, filthy rich by developing it and selling the systems . . . and not just to hams. Hey, put me down for 2%, okay?

Breast Cancer

A reader who, for some perverse reason, enjoyed my editorial on bioelectricity, wrote to say that while he was visiting England a few years ago the BBC broadcast a program showing a breast cancer treatment in Sweden where they put a probe (needle) in the middle of the cancer with +12 volts on it and ringed the cancer with -12V probes. The result after a short application of the voltage was a quick cure.

You'll learn more about this sort of thing in the Bob Becker books I recommended.

I'm reminded of Michael Crichton's book, *Travels,* where he pointed out that radical mastectomy for breast cancer as an example of superstitious behavior in that there is no scientific evidence that there are any benefits. Except perhaps to the doctors and hospitals, who reap millions. Mike was a doctor before he got into writing and directing. You'll enjoy this $4.95 pocketbook. Look for it.

Free Music? What's This, Another Con Job?

We keep hearing there's no free lunch, but every time someone puts out some food we belly up to the table and start eating, hoping this time it's for real. So what's all this free music stuff? What's the catch? Well, it isn't totally free, but it's darned close. Close enough so you can build one heck of a music library for peanuts. You can build yours the same way I built mine. The English language is pitiful when it comes to expressing feelings, so I can't begin to tell you how excited, happy, sad, enthralled I am when listening to Joplin, Nazareth, Sibelius, Glière. No more than I can explain the excitement of skiing hard and fast down a slope or scuba diving on a reef full of fish. Why are contests so much fun? Why do DXers chase a rare one for hours? What's the fun of sitting in some rare country and working the pileups?

But a music library is something you have for life. I can pull out *The Music Man* CD from Telarc and enjoy the incredibleness of the music, the lyrics, the performance and the recording. We haven't got the words in English to communicate this. Nor can I ever really explain to you the feelings of combined happiness and angst I experience in listening to Joplin's music as played by Scott Kirby. Or the emotional experience of César Franck's symphony played on a good hi-fi system. I can only do my best and hope you'll join me in enjoying the things I have found so exciting.

You? A Music Expert?

Yes, you! Look, everybody, including you, likes some kind of music. Whether you enjoy rock, ragtime, blues, Dixieland, jazz, bluegrass, polka, or old-time fiddle music, there are some kinds of music that you like. You are a music expert on one thing: the music you like to hear. Okay, now I've got a way you can cash in on your expertise.

Sure, some people like music more than others. Some not only listen to music on the radio and buy records, they go to concerts! A few even go to music festivals, which are popping up

all around the country. Even way up here in the mountains of New Hampshire we have a restaurant that specializes in blues (Rynborn in Antrim), another in folk music (The Folkway in Peterborough), and one in bluegrass (Del Rossi's in Dublin).

But no matter how much or little you love music, you are an expert on what music you like, and there are record companies out there that want to find out what you like. This is where the Music Research Foundation comes in. This is also where you can build one heck of a music collection for peanuts. Damned near free, actually.

So who's going to shell out to send you music and why? Just put yourself in the big fat luxurious chair of a record company executive. You know the odds are only about one in 20 that your next new release is going to pay for itself, much less be a hit. And this despite all the experts you have on your staff, and your own intuition. It's worth a lot to you to have a focus group listen to your new releases and rate each one on how much they like it. You don't want music-Ph.D. expert opinions, you want to know how much the general public is going to like your release.

Record Companies Need to Know

This information allows the record companies to put their major promotion money behind the winners and not waste big bucks on losers. Promotion can't make a lousy record into a hit, but the lack of it can keep good music from getting anywhere. This same information is also helpful for record store managers when they're deciding how many copies of a new title they should order.

The Music Research Foundation has been providing this rating service to a few record companies, but it's been so successful in picking hits that now many more want it. Thus, the Foundation is looking for volunteers to get newly released CDs and cassettes and rate them. The record companies provide the review CDs and CAs to the Foundation for the Research Associate groups. All the Foundation charges is $3.86 each for CDs and $2.77 for cassettes, just to cover the handling, shipping and record-keeping.

Since there are many types of music, the Foundation needs hundreds more Associates to help evaluate them all. If you're interested, let the Foundation know what kinds of music you like and send a $10 registration fee (check or credit card) to cover the cost of setting up your enrollment and shipping the first three CDs or CAs for you to rate.

Over the last 10 years I've rated well over 5,000 new CD releases, plus I've written some 3,000 in-depth reviews for my music publications. The result is that I have built a superb music collection of classical, ragtime, theater organ, operettas, country, bluegrass, folk music, foreign, dance, show tunes, old time piano, choral, and so on. Nope, not much rock, blues, new age, or jazz. With several hundred new releases every month, there's no shortage of music.

"So what's all this free music stuff? What's the catch?"

You Haven't Got Time?

Somehow, despite my fairly busy schedule, I manage to put in at least an hour a day listening to new releases. Even on trips I have a portable CD player with me and a box of CDs to rate. That's "work" that is very relaxing. Scientists are just now beginning to recognize the therapeutic aspects of music. Heck, when I was the Executive Director of the Music Research Foundation back in 1952 I worked with a group of New York's top psychiatrists and psychoanalysts and wrote a book on the subject which the Foundation published.

Record companies and record retailers need to know which new releases you, as a representative of the general public, like. So give them and yourself a break and start getting your almost free music. Most of the CDs sell for from $15 to $20, so you can build a valuable CD collection in short order. I know mine couldn't be replaced for $100,000.

Here's your opportunity to have fun, build an enviable music collection, and help the music industry to improve its product. Wouldn't it be great if the ham manufacturers wanted vox pop reactions to their products? Dream away—but listen to some wonderful music while you're dreaming.

Send your $10 to: The Music Research Foundation, Research Associate Fulfillment Division, 70 R 202 N, Peterborough NH 03458-1107, or call 800-234-8458 with your credit card number.

Ordering Books and CDs

[Editor's Note: Wayne often references books and CDs in his editorials. The books are often available from Uncle Wayne's Bookshelf; the CDs from IMPS by Mail. Both can be ordered by telephoning (800) 234-8458 or (603) 924-4196, or by faxing (603) 924-8613.]

Number 27 on your Feedback card

SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the January issue, we should receive it by October 31. Provide a clear, concise summary of the essential details about your Special Event. Check ***Special Events File Area #11*** *on our* ***BBS (603-924-9343)****. for listings that were too late to get into publication.*

APRIL 2

CHESAPEAKE, VA C.A.R.S. "Springfest" Amateur Radio/Computer Show will be held at the Virginia Beach Pavilion from 8 AM-3 PM. VE Exams given by CDXA. Talk-in on 146.97-. Dealer Contact: *Preston P. Ipock N4SHI, 1026 Calloway Ave., Chesapeake VA 23324. Tel. (804) 543-4610.* Flea Market Contact: *Robert M. Holt N4SFH, 2539 Roundtree Cir., Chesapeake VA 23323. Tel. (804) 487-1896.*

COLUMBUS, IN The Columbus ARC will host a Hamfest at Bartholomew County 4-H Fair Grounds, Family Arts Bldg., on State Rd. 11, from 8 AM-2 PM. Talk-in on 146.790/.190. Make reservations thru *Marion Winterberg WD9HTN, 11941 W. Sawmill Rd., Columbus IN 47201. Tel. (812) 342-4670.*

EAST LYME, CT The Southeast Connecticut Radio Amateur Mobile Soc. (SCRAMS) will hold its annual Spring Auction at the Senior Citizens Center, Waterford Municipal Complex. Setup at 9 AM. Auction from 10 AM until sold out. Bring your equipment to be auctioned. Talk-in on 146.07/.67 Rptr. For info, call *KA1BB at (203) 739-8016.*

LONGMONT, CO The Longmont ARC will hold its annual LARCFEST from 8 AM-3 PM at the Boulder County Fairgrounds, Hover and Nelson Rds. VE Exams at 1 PM. Talk-in on 147.27/.87 or 146.52. Contact *Randy Stevens N0NMD, 5280 Cypress Dr., Boulder CO 80303. Tel. (303) 499-1106.*

APRIL 9

FERGUS FALLS, MN The Lake Region AC will sponsor their 7th annual ARRL Affiliated Hamfest between 8 AM-3 PM, at the Hockey Arena, Otter Tail County Fairgrounds. VE Exams. ARRL Forum. Packet Meeting. More. Contact *Keith McKay N0FKF, Rt 1 Box 46, Battle Lake MN 56515. Tel. (218) 826-6274.*

LAWTON, OK The Lawton Ft. Sill ARC will hold the 48th annual LFSARC HAMFEST from 8 AM-5 PM at the Comanche County Fairgrounds in Lawton. Talk-in on 146.91/.31. Write to *Bob Morford KA5YED, 1415 N.W. 33rd St., Lawton OK 73505*; or call *(405) 355-6120.*

ROCHESTER, MN The Rochester Area Hamfest/Computer & Electronic Show will begin at 8 AM at John Adams Jr. H.S., 1525 31st St. NW. Talk-in on 146.22/.82 (W0MXW Rptr.); 223.22/224.32 (W0MXW Rptr.). Contact *Rochester ARC, Attn: Colleen Vaneps N0ZDY, 707 11 1/2 St. SW, Rochester MN 55902. Tel. (507) 280-9102.*

APRIL 10

MADISON, WI The Madison Area Repeater Assn., Inc., will hold its 22nd annual Madison Swapfest at the Dane County Exposition Center Forum Bldg. beginning at 8 AM. (Set-up 7 AM). Talk-in on 147.75/.15 on the M.A.R.A. Rptr. (WB9AER). Reservation deadline is March 31st. Write to *M.A.R.A., P.O. Box 8890, Madison WI 53708-8890*; or call *Jim Waldorf KB9AQQ, (608) 249-7579.* Leave a message on the answering machine.

NEW CASTLE, DE The Penn-Del ARC will present its annual Hamfest at the Nur Temple on RT. 13. Open 8 AM-2 PM (setup at 6:45 AM. Register for VE Exams at 9 AM. Packet and ATV Demos. Talk-in on 147.225+ and 224.220/R. Send reservations to *Penn-Del Hamfest, P.O. Box 1964, Boothwyn PA 19061.* For info call *(302) 798-7270.*

TRENTON, NJ The Delaware Valley Radio Assn. will sponsor HAMCOMP '94, their 22nd annual Flea Market of amateur radio and computer equipment. The event will be held from 8 AM-1 PM on the campus of Trenton State College, Route 31, Ewing Township, Trenton NJ. Wheelchair accessible. Talk-in on 146.07/.67. Contact *HAMCOMP '94, P.O. Box 7024, West Trenton NJ 08628. Tel. (609) 882-2240.*

APRIL 16

JOPLIN, MO A Hamfest, sponsored by the Joplin ARC, will be held at John Q. Hammons Trade Center from 8 AM-3 PM. VE Exams. Flea Market. More. Talk-in on 147.210+. Call for details at *(417) 623-3610 (days); (417) 782-5848 (eves)*; or *J.A.R.C., P.O. Box 2983, Joplin MO 64803.*

APRIL 17

RALEIGH, NC The Raleigh ARS will present its 22nd Hamfest, ARRL NC State Convention and Computer Fair, in the Jim Graham Bldg., NCS Fairgrounds, from 8 AM-4 PM. ARRL, QWCA, MARS, ARES, more. Pre-register for VE Exams by calling *AA4MY at (919) 847-8512.* For info, contact *Rollin Ransom NF4P, 1421 Parks Village Rd., Zebulon NC 27597. Tel. (919) 269-4406.* Talk-in on 146.64 -600.

APRIL 30

SONOMA, CA The Valley of the Moon ARC, WB6DWY, will hold its annual "Ham" and Egg Breakfast and Swap Meet, starting at 8 AM at the Sonoma Veteran's Memorial Bldg., 126 First St. West. VE Exams; walk-in, with registration at 10 AM. Testing begins at 11 AM. Talk-in on 147.47 simplex, and the 145.35 -600 and 146.205 +600 Rptrs, PL 88.5. Contact *Darrel WD6BOR, (707) 996-4494.*

MAY 1

BURLINGTON, IA Valley Emergency Comm. Assn. will host Burlington Hamfest '94 from 7:30 AM-3 PM, at the Burlington Drive-In Theater, Agency St. (off U.S. 34

and U.S. 61). Talk-in on 146.790/.190 W0LAC/R and 146.520 simplex. Contact *Chuck Gysi N2DUP, Burlington Hamfest '94, P.O. Box 911, Burlington IA 52601-0911*, or call *(319) 752-3000 (voice/fax).*

YONKERS, NY The Metro 70cm. Network will present a Giant Electronic Flea Market at Lincoln H.S., 9 AM-3 PM, rain or shine. VE Exams. Talk-in on 440.425 MHz PL 156.7; 223.760 MHz PL 67.0; 146.910 Hz; and 443.350 MHz PL 156.7. Mail paid reservations to *METRO 70 CM NETWORK, 53 Hayward St., Yonkers NY 10704.* For details, call *Otto Supliski WB2SLQ, (914) 969-1053.*

MAY 7

MANITOWOC, WI The Mancorad RC will hold its annual Hamfest from 8 AM-?? at the Manitowoc County Expo Ctr. Amateur/Computer/Electronics Flea Market. VE Exams. Contact w/SASE to *Mancorad RC, P.O. Box 204, Manitowoc WI 54221-0204*; or call *Red, (414) 684-9097 days; Ron (414) 793-4733 eves.*

SPECIAL EVENT STATIONS

APRIL 2-3

TULSA, OK The Tulsa ARC will celebrate its 70th Anniversary by operating W5OK, from 18:00Z 2 April-18:00Z 3 April. Frequencies: Phone—lower 50 kHz of the General 15, 20, 40, 80 meter subbands, and the Novice 10 meter subband. There will also be a 2 meter SSB station. CW—lower 25 kHz of the General 20, 40, 80 meter subbands and the Novice 15 meter subband. For a unique certificate, send QSL and a 9x12 SASE to *Tulsa ARC, P.O. Box 4283, Tulsa OK 74159.*

APRIL 3-9

TWEED HEADS, N.S.W., AUSTRALIA Station VI2CQ will operate approx. 2300 UTC-0000 UTC and 0300 UTC-0500 UTC from Camp Quality (Kids with Cancer), in the Tweed Heads area of NE New South Wales. It will be manned mainly by the VK4 Gold Coast ARS Inc. Frequencies: 7.050, 14.150, 21.150 and 29.550, all +/- QRM. QSL via *VK2CYI, VK2 Bureau.* A QSL card will be sent for all contacts.

APRIL 7

GLENBROOK, N.S.W. In commemoration of the 140th Anniversary of the first Morse telegraph circuit in Australia (between Melbourne and Williamstown), the Sydney Morsecodians Fraternity will establish a Morse link between Melbourne and Williamstown (with the venues at each end yet to be identified). The Science Centre in Canberra will be linked with both terminals so that messages may be exchanged between the three centers. Visitors will be able to send brief telegrams to relatives or friends, without charge.

APRIL 9-10

GREEN VALLEY, AZ The Green Valley ARC will operate KC7MF 1600Z April 9th-2300Z April 10th, to commemorate the closing of all TITAN 2 Missile Sites in the USA. Phone Bands: 3.860 (AM or SB), 7.230, 14.250, 21.330, 28.450 MHz. For local 2m Rptr. operation, use 145.290 MHz (-600). For a certificate, send QSL and an 8x12 SASE to *GVARC, 601 N. La Canada, Green Valley AZ 85614.*

APRIL 11

MOBILE, AL The Mobile ARC will operate K4RQQ in commemoration of the 94th Anniversary of Submarines USN. Operation will be from the USS DRUM at Battleship Park. Frequencies: 20m 14.220-14.280; 146.22/.82 for locals. For a certificate, send QSL and 9x12 SASE to *Murray Flanders K4RQQ, 9075 Howells Ferry Rd., Semmes AL 36575-7502.*

APRIL 22-23

ADAMS, NY Members of Jefferson County ARC will operate N2DMZ 1400Z-2400Z April 22nd and 23rd, to commemorate the birth of J. Sterling Morton, the founder of Arbor Day. Operation will be in the lower 25 MHz of General 80, 40, 20 and 15m CW and phone subands. Try 14.060 +/- for CW QRP. For a special QSL card, send SASE and QSL to *John Wagner N2DMZ, 20 Robert St., Adams NY 13605.*

APRIL 22-24

BAY CITY, TX The Matagorda County ARC will operate N5QWF from 0000Z-2400Z April 22-24, to celebrate the Bay City Centennial. The Station will operate on all bands, in all modes. For a QSL card, send SASE to *N5QWF, 4404 Doris St., Bay City TX 77414.*

SPARKS, GA The Middle Georgia Pro Ams will sponsor Station AA4RI, to commemorate the 100th Anniversary of "wireless" and the 120th Anniversary of Guglielmo Marconi's birth (25 April 1874). Operation will begin 22 April at 2100 UTC, and continue until 1800 UTC 24 April. Listen for AA4RI in the lower 25 kHz of the General bands. Hams traveling on I-75 will be invited to visit and operate this Station. For a certificate, send a 9x12 SASE, with QSL card to *Curtis Carter, 114 Belmont Dr., Warner Robins GA 31088.* For DX stations not desiring a certificate, QSL cards will go out via the bureau.

APRIL 29-30

DAYTON, OH Special Event Station W8BI/8 will again operate from the Dayton Hamvention Flea Market, during Flea Market hours (1200Z-2200Z April 29th; 1000Z-2100Z April 30th. Operation will be in the General and Novice phone, and CW portions (as band conditions dictate). W8BI/8 QSLs 100% to hams and SWLs. To QSL, send a business-size SASE to *W8BI/8, P.O. Box 44, Dayton OH 45401.*

APRIL 30

SONOMA VALLEY, CA The Valley of the Moon ARC, WB6DWY, will operate in commemoration of the City of Sonoma and the Valley of the Moon's rich historical heritage, from 1700 UTC-2400 UTC. The station will be operated during the club's annual Hamfest. Listen throughout the day on the General phone portions of 10, 20 and 40m. For a nice parchment certificate, QSL with SASE to *VOMARC, 358 Patten St., Sonoma CA 95476.*

APRIL 30-MAY 1

PHILADELPHIA, PA The Olympia ARC will operate WA3BAT from 1300Z April 30th-2000Z May 1st, to commemorate the 96th Anniversary of Admiral Dewey's triumph over the Spanish Fleet at the Battle of Manilla Bay. SSB/Phone—3.898, 7.268, 14.268, 21.368, 28.368, 145.270, and packet. For a certificate, send QSL and a 9x12 SASE to *Olympia ARC, P.O. Box 928, Philadelphia PA 19105.*

Number 30 on your Feedback card

PROPAGATION

Jim Gray W1XU

Jim Gray W1XU
210 East Chateau Circle
Payson AZ 85541

April is usually a very good month for RF propagation, and should be fairly good this year in spite of the declining sunspot numbers and solar flux levels. Don't expect April to be a passive month, however, as there are signs of possible ionospheric upsets and disturbances in the earth's magnetic field, particularly between the 6th and 10th of the month. You may also expect some other geophysical effects around this time, such as storms in the atmosphere and other manifestations in the earth itself, but *not as great* as the January 17th-21st period. Such occurrences need not happen only in the United States, either, but they will likely be somewhere on earth.

Winter has transitioned into spring in the Northern Hemisphere, and the usual thunderstorm activities in lower elevations and snow in the higher ones, such as the Rocky Mountains, can be expected. Anticipated DX conditions during the month follow.

10-12 Meters

Fairly good daytime conditions on north-south paths, particularly in the afternoon. Also some east-west openings to Africa and the Pacific on Good (G) days. Short skip between 1,000 and 2,000 miles will occur during the daytime hours, with movement to the west following the sun. These bands will close around local nightfall.

EASTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA	20	20						15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40	40		20	15	15	15	15	
SOUTH AFRICA									15	15	15	
U.S.S.R.							20	20				
WESTCOAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	20	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
SOUTH AFRICA										15	15	20
U.S.S.R.								20	20			

WESTERN UNITED STATES TO:

ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20	20				15
PHILIPPINES	15							40		20		
PUERTO RICO			20	20	20	20	20	20				15
SOUTH AFRICA										15	15	
U.S.S.R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

15-17 Meters

Fairly good DX openings to all areas of the world on Good (G) days, and occasionally on Fair (F) days or days trending from Fair to Good or vice versa. Expect openings from the Northern Hemisphere to Africa, South America and the Pacific, peaking in the afternoon. Short skip, during daylight hours, of 1,000 miles or so is likely on many days.

20 Meters

Very good DX openings to all areas of the world from sunrise through the early hours of darkness. Openings should peak an hour or two after sunrise and again in the afternoon. Short skip openings beyond 750 miles should occur during most days in the daylight hours. This should be your best band for DX opportunities, with strong signals on Good (G) days.

30 and 40 Meters

Fairly good worldwide DX openings from early evening through sunrise. Short skip will occur over 1,000 miles during hours of darkness, and between 100 and 1,000 miles during daylight hours. The 30 meter band exhibits some characteristics of 20 meters and some of 40 meters. These bands are subject to thunderstorm QRN, however, and on Fair (F) days signals may not be much above the noise level. Static crashes are always a problem when thunderstorms are present within the skip zones.

80 and 160 Meters

These are the wintertime bands, when noise levels are low, but some good results can be obtained this month, too, particularly from the Northern Hemisphere to Central and South America and other areas of the Southern Hemisphere. East-west openings are rare but daylight short skip openings of up to 350 miles are possible on 80 meters, and over 500 miles during nighttime hours. On 160 meters, you will find some DX openings that peak around midnight and around sunrise, but there will be NO daylight chances for short skip or otherwise because of high signal absorption levels during the day.

In general, April may turn out to be one of the better months until fall for your DX opportunities. Because of the lower values of solar flux, openings will be fewer in number and farther between. Use the charts wisely for best results, and monitor WWV at 18 minutes after each hour for updates on the ionosphere.

April 1994

SUN	MON	TUE	WED	THU	FRI	SAT
					1 P-F	2 F
3 F	4 F	5 F-P	6 P	7 VP	8 P	9 P
10 VP	11 P	12 P	13 P-F	14 F	15 F-G	16 G-F
17 F-G	18 G	19 G-F	20 F-G	21 G	22 G-F	23 F-P
24 P-F	25 F	26 F	27 F	28 F-G	29 G	30 G-F

Number 28 on your Feedback card

NEW PRODUCTS

Compiled by Charles Warrington WA1RZW

KENWOOD

There's a new rig coming soon from Kenwood—the TS-60S 90 watt 6 meter transceiver—and it is designed in the same style and configuration as the popular TS-50S HF transceiver.

Main features include a full 90 watts output on SSB, CW, and FM modes; 23 watts on AM mode; 100 memory channels; Direct Digital Synthesizer with fuzzy logic control; a large LCD panel with a digital bar meter; a multi-function microphone; and much more.

The suggested retail price for this all-mode transceiver is $1,209.95. For more information visit your favorite Kenwood authorized amateur radio dealer or contact *Kenwood Communications Corporation, P.O. Box 22745, Long Beach, CA 90801-5745; (310) 639-4200.*

NCG COMET

With the downsizing of most handheld transceivers available today, Comet has introduced a fine quality speaker-microphone in a compact size to match. The new Comet HM-P2 may be the smallest speaker-mike you'll ever see, measuring approximately 1" wide by 2" high. The rugged plastic shell houses the feather-light unit, which exhibits excellent transmit and receive quality.

The HM-P2 does everything a comparable large speaker-mike can do and features a dynamic microphone element. The suggested retail price is $32.95 and it is available at most dealers nationwide. For more information contact *NCG Comet Antenna, 1275 North Grove Street, Anaheim, CA 92806; (714) 630-4541; FAX (714) 630-7024.* Or circle Reader Service No. 203.

JPS COMMUNICATIONS

JPS Communications, Inc., has introduced the new NTR-1 Wide Band Noise and Tone Remover to the amateur radio market. The NTR-1 is a general purpose audio processing unit designed specifically to provide noise reduction and multiple tone removal for AM, FM, or other wideband signals, at an affordable cost.

This handy unit uses Digital Signal Processing to provide operating characteristics far superior to those attainable using analog techniques. Both WIDE (approx. 6.8 kHz) and NARROW (approx. 3.4 kHz) bandwidths are provided to give optimum performance for AM or FM signals as well as SSB, CW, or data. For more information contact *JPS Communications, Inc., P.O. Box 97757, Raleigh, NC 27624-7757.* Or circle Reader Service No. 204.

A & A ENGINEERING

Dr. Ralph Taggart WB8DQT has just released his Weather Satellite Handbook Software (WSHFAX) and A & A Engineering has worked with Dr. Taggart to create a compatible interface hardware package. The interface is A & A's Product #200 and is available in kit form or assembled and tested.

This unit is featured in the Fifth Edition of the *Weather Satellite Handbook.* It will process both HF and satellite weather FAX. The software will run on any PC/XT/AT/PS1/PS2 compatible with at least 640K of RAM and one floppy, parallel port, and VGA display. Kit price is $159.95 or assembled for $189.95. For shipping within the USA please add $6.50. For more information contact *A & A Engineering, 2521 W. LaPalma, Unit K, Anaheim, CA 92801; (714) 952-2114.* Or circle Reader Service No. 207.

ICOM

Icom has introduced the new IC-2GXAT hand-held transceiver, with the highest power in its class, along with a multitude of other advanced features at a very reasonable price. This beauty offers simple operation, advanced features and durable construction.

You can operate the IC-2GXAT 2 meter HT by channel number only, if you wish—keeping frequencies secret, restricting frequencies, or simplifying operation for an unfamiliar user. Other features include auto repeater operation, tone scan, DTMF redial, and a user-friendly keyboard.

For further information visit your local Icom dealer or contact *Icom America, Inc., 2380 116th Ave. NE/P.O. Box C-90029, Bellevue, WA 98009-9029; (206) 454-7619; Telex 152210; FAX (206) 454-1509.* Or circle Reader Service No. 201.

AEA

Advanced Electronic Applications recently introduced something new for the satellite operator. The ST-1 Satellite Tracker offers the satellite enthusiast hardware and software for the automatic tracking of satellites.

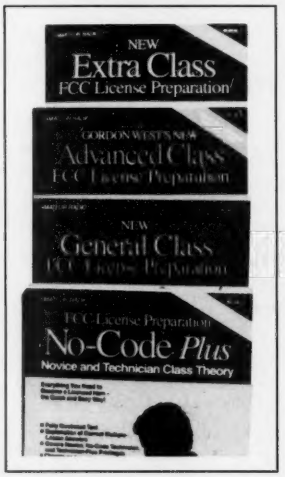
The ST-1 offers hands-off control of antennas and transceiver tuning to make satellite operation easy. As the satellite nears the horizon, the antennas are pointed in the proper direction and the rig is tuned to the right uplink and downlink frequencies. As the satellite moves into the field of view, the antennas track and the transceiver tuning is corrected for the Doppler shift throughout the pass.

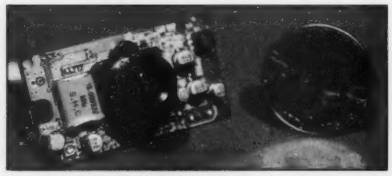
The system has many other fine features, and is priced at $399. For more information, please contact *Advanced Electronic Applications, Inc., P.O. Box C2160, Lynnwood, WA 98036; (206) 774-5554; FAX (206) 775-2340.* Or circle Reader Service No. 202.

GORDON WEST

Well-known author and *Radio Fun* columnist Gordon West has just finished a four-year project of amateur radio test-preparation manuals with the release of his new Extra Class theory book. "The complete selection of training materials for all radio license grades is a continuous process," said West. "Just as I finish a new book, I go back and begin the yearly revision of another book for the July 1st question pool change."

All of the Gordon West amateur radio license preparation books and code tapes are available from amateur radio dealers throughout the country. For more information or to mail an order, contact *Gordon West c/o the W5YI Group, P.O. Box 565101, Dallas, TX 75356-5101; (800) 669-9594.* Or circle Reader Service No. 205.





SUPERCIRCUITS

Imagine screaming along, just inches off the ground, at 60 mph. Or how about nose-diving straight down from 1,000 feet up, and pulling out at the last moment? The Supercircuits PC-10XS microvideo camera is what makes it happen!

For a really exciting project, try mounting the PC-10XS microvideo camera and a miniature amateur TV transmitter to a model rocket, R/C airplane, car, or helicopter. Live video telemetry can be thrilling and it is easier than you think. The unit weighs in at one ounce, produces a sharp 380 lines resolution, and works well in low light with an auto-exposure control. For more information contact *Supercircuits, 13552 Research Blvd., Austin, TX 78750; (512) 335-9777.* Or circle Reader Service No. 206.

Number 29 on your Feedback card

BARTER 'N' BUY

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to the Barter 'n' Buy, Judy Walker, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls.

The deadline for the May classified ad section is March 10, 1994.

ALL ABOUT CRYSTAL SETS. Theory and construction of crystal set radios. $7.95 each, ppd USA. Send to: **ALLABOUT BOOKS**, Dept. S, P.O. Box 22366, San Diego CA 92192. BNB200

CUSTOM MADE-HAND TOOLED leather products with your initials, name, call letters. Photo's & estimates available. Key rings, wallets, belts, purses, hanging signs, specialty items. GREAT GIFT. **LEATHER & WEST,** 67 Causeway Rd., West Swanzey NH 03469. (603)352-6256. 9-4 pm. M-F ET. BNB215

SUPERFAST MORSE CODE SUPEREASY. Subliminal cassette. $12. LEARN MORSE CODE IN 1 HOUR. Amazing supereasy technique. $12. Both $20. Moneyback guarantee. Free catalog: SASE. **BAHR-T2,** 150 Greenfield, Bloomingdale IL 60108. BNB221

KENWOOD TS-830S, XTRA TUBES. Ameritron AL-811 amp. MFJ-949D versa tuner. MFJ-815B swr meter. Everything perfect condition. Whole package $1348/BO you pay shipping. Steve (303)945-0639. BNB245

QSL SAMPLES- 50 cents. **SAMCARDS,** 48 Monte Carlo Dr., Pittsburgh PA 15239. BNB275

COMMODORE 64 REPAIR. Fast turn around. **SOUTHERN TECHNOLOGIES AMATEUR RADIO,** 10715 SW 190th Street #9, Miami FL 33157. (305)238-3327. BNB295

SILICON VALLEY Treasures, Caps, resistors, diodes, MORE. 100 pcs $2.00, 500pcs $5.00, 1000pcs $9.00. Post paid in US. **LYNN JOHNSON ELECTRONICS,** Box 51268, San Jose CA 95151-1268. BNB300

WANTED: Electron Tubes, ICS, Semiconductors. **ASTRAL,** P.O. Box 707ST, Linden NJ 07036. Call (800)666-8467. BNB307

KENWOOD AUTHORIZED REPAIR. Also ICOM, Yaesu. **GROTON ELECTRONICS,** Box 379, Groton MA 01450. (508)448-3322. BNB310

OLD TUBES. Write K1KOL, Box 131, Newton NH 03858. BNB335

RCI-2950 OWNERS: New modification manual including Power increase. Clarifier modification. Modulation increase. Operating hints, and more. Parts included. Only $20.00 ppd in U.S. (Missouri residents add $1.15 tax). **SCOTT**, P.O. Box 510408, St., Louis MO 63151-0408. (314)846-0252. Money Orders or C.O.D. BNB340

HR2510, RCI2950, CONNEX 3300, COBRA 148, GALAXY SATURN, plus many more kits to increase your modulation, $19.95. **(800)536-0109.** BNB350

KIT BUILDERS! Complete list of 165+ kit vendors. #10 SASE + $3.00 USD to: **RUTENBER ENGINEERING,** 38045 10th St. E. #H75-AR, Palmdale CA 93550. BNB365

QSL CARDS — Standard and custom. Your ideas or ours. Excellent quality. Foil stamping available. Many designs and type styles. Catalog and samples $1.00 refundable. **WILKINS,** Dept. A, Box 787, Atascadero CA 93423. BNB370

NEW NN1G CW SUPER-HET SINGLE BAND TRANSCEIVER KIT. Available in 20M, 30M, 40M, 80M. $59.95 plus $3.75 S/H. (Catalog-2 Stamps). **DAN'S SMALL PARTS & KITS,** 1935 South 3rd West #1, Missoula MT 59801. BNB385

SERVICE MONITORS WANTED. Any late model test equipment. (408)241-7376. BNB390

MAHLON LOOMIS, INVENTOR OF RADIO, by Thomas Appleby. Available from Johan K.V. Svanholm, N3RF, **Svanholm Research Laboratories,** P.O. Box 81, Washington DC 20044. Please send $25.00 donation with $5.00 for S&H. BNB420

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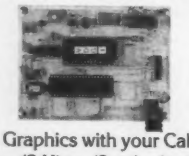

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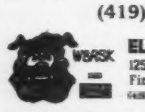

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ICOM-781 RAFFLE: One hundred tickets ONLY at $100 a piece. Drawing to be held at 3pm on June 24 at the RC of JHS 22 in NYC. Tickets/Questions-RC of JHS 22, POB 1052, New York NY 10002. Phone (516)674-4072, FAX (516)674-9600. BNB455

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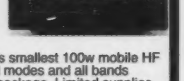


Enjoy high performance communications plus go-anywhere convenience with the world's smallest 100w mobile HF transceiver. All modes and all bands complete this package. Limited supplies.

FLASH Kenwood extended coupon to 3/20/94

PRICE WATCH PRICE WATCH

TH-78A

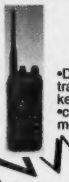
Compact and confident, this dual band HT sets exciting new standards for portable communications by combining simplicity of operation with a multiplicity of features.

WOW NEW TM-251

KENWOOD

* NEW IC-281

IC-T21A



•Dual receive •Single band transmit •6 watt output •lit keypad •fast scan •DSQ •clock •114 memories and more.

$325.95 $284.95 with all coupons & discounts

IC-2GXAT

This compact high power design sets a new pace •6 watt output •40 memories •Die cast case •CTCSS and more.

* FCC Acceptance Pending

ICOM

TH-22/AT

$262.55 with all coupons & discounts

Small just got smaller. Kenwood's new TH-22AT is in a category all its own. This new FM transceiver features long battery life, DTMF keypad, user-friendly menu system, scan functions, 41 memories, CTCSS encode, DTSS, and much more.

IC-707

$839.95 with all coupons & discounts

Here's 9 pounds of fun with a display that's easy to see, a front panel that's easy to work with, and performance to spare. You get big rig specs in an HF transceiver designed for mobile and portable use.

Not Responsible For Typographical Errors.

Radio City Expires April 1994

Prices Subject To Change Without Notice.

Authorized Factory Warranty Center

We offer factory authorized warranty service for Icom, Kenwood and Yaesu. We service all makes and models. Our customers may send any product requiring service to us, and we will handle it for them. This is a one-stop service that keeps our customers having more fun than hassle in this hobby. If you need a custom cable for packet and don't have time to make it, let us do it for you. C.A.P. & M.A.R.S. mods are also available at reasonable rates to authorized hams only.

2663 County Road I, Mounds View, MN 55112
Metro: (612) 786-4475 • Nat'l Watts: 1-800-426-2891 • FAX (612) 786-6513

Store Hours: M-F, 10:00 am - 8:00 pm, Sat., 10:00 am - 5:00 pm
Phone Hours: M-F, 8:00 am - 8:00 pm, Sat., 10:00 am - 5:00 pm

FT-2200/7200
2-m/70-cm Mobiles

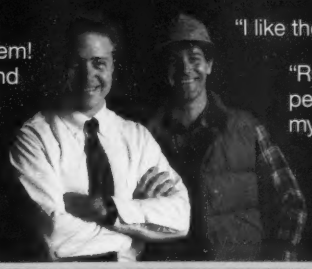
- **Frequency Coverage:**
  FT-2200
  RX: 110-180 MHz
  TX: 144-148 MHz
  FT-7200
  RX/TX: 430-450 MHz
- 50 Memory Channels
- Wide Receiver Coverage: 110-180 MHz
- AM "Aircraft" Receive: 110-139 MHz *
- Built-In DTMF Paging/Coded Squelch
- Power Output 50/25/5 Watts*
- CTCSS Encode Built-In
- 10 Memory DTMF Auto Dialer
- Selectable Channel Only Display
- Remote Operation w/ Optional MW-2
- Optional Digital Voice Storage System
- Backlit DTMF Mic
- **Accessories:**

FTS-27	CTCSS Decode Unit
DVS-3	Digital Voice System Unit
MW-2	Remote Control/ Wireless Mic
SP-7	External Speaker

*FT-2200 only.

"The FT-2200 answers my problem! It fits anywhere, and the 3 power levels are great!"

"Yaesu did it again!"



"I like the FT-2400H!"

"Rugged performance is my answer!"

For your sleek compact car, the sculptured FT-2200 looks terrific. With leading-edge features, performance and reliability too, it's the perfect answer to your 2-m needs.

At 5.5"W x 1.6"H x 6.5"D the FT-2200 installs nearly anywhere. And, it does "lead" with features like optional Remote Control Wireless Mic – first in the world for any 2-m mobile and AM Aircraft Receive – first in a Yaesu mobile. Performance? The FT-2200 has more than twice the memories of the competition! Reliability? Its bright, new LCD display and backlit DTMF Mic makes night mobiling safe. Features, performance, reliability – in a powerful little package. See your dealer for *this* answer to your 2-m needs.

The Yaesu FT-2400H set the standard by which all 2-m mobiles are judged. The first and only amateur radio to pass rugged MIL STD 810D tests for shock and vibration, its one-piece die-cast chassis with extra large heat sink gives years of trouble-free operation.

With 50 watts of TX power, large alpha-numeric display, auto display dimmer, exclusive backlit DTMF Mic and advanced track tuning front end for superior receiver performance, the popular FT-2400H is the choice of amateurs in the know.

Features, performance, reliability – ready to go anyplace. See your dealer for *this* answer to your 2-m needs.

FT-2400/7400H
2-m/70-cm Mobiles

- **Frequency Coverage:**
  FT-2400H
  RX:140-174 MHz
  TX: 144-148 MHz
  FT-7400H
  RX/TX: 430-450 MHz
- Rugged Mil-Spec Design
- Advanced Track Tuning (ATT)
- 31 Memory Channels
- Wide Receiver Coverage: 140-174 MHz
- Selectable Alpha-Numeric Display
- Largest 2-Meter Display Available
- CTCSS Encode Built-In
- Power Output 50/25/5 Watts *
- Flip Up Front Control Panel Hides Seldom Used Buttons
- Backlit DTMF Mic
- **Accessories:**

FTS-17A	CTCSS Decode Unit
FRG-6	DTMF Paging Unit
SP-4	External Speaker
FP-700	Power Supply

*FT-2400 only.

FT-7200 IS NOW AVAILABLE!

Yaesu answers your 2-m mobile needs.

YAESU

Performance without compromise.℠

Kenwood's TM-942A/742A/642A—

Triple Triumph

TM-942A/742A/642A

FM MULTIBANDER

Good things come in threes. Like Kenwood's distinctive TM-942A (144MHz/440MHz/1200MHz), TM-742A (144MHz/440MHz), and new TM-642A (144MHz/220MHz)—high-performance FM multibanders that demonstrate the best in mobile communications technology. Besides offering triple receive and display capability, the TM-942A can even receive all three bands simultaneously. For the TM-742A and TM-642A, you can choose one of several optional band units, enabling triple band operation with the same triple simultaneous receive. Top-notch features include 101 memory channels (all available for split operation), automatic band change, DTSS with page, and S-meter squelch. There's even a wireless remote control function. Yet operation is remarkably simple, thanks to sophisticated microprocessor control, high-visibility illuminated keys, and clear status displays. You wouldn't expect any less from Kenwood. But there's more: you can mount the controls and display separately from the main unit (requires optional kit) for unique 3-way convenience.

Features

- Max. 50W output (144MHz), 25W (220MHz), 35W (440MHz), 10W (1200MHz)
- 101 memory channels & memory bank system
- Independent SQL & VOL controls for each band
- Automatic band change
- Built-in DTSS selective calling feature with page
- Selectable frequency step ■ 8 scan modes per band
- Time Operated & Carrier Operated scan stop modes
- Direct frequency entry with supplied microphone
- Tone alert with elapsed time indicator
- S-meter squelch, noise squelch & auto squelch
- Cross-band repeater ■ Muting for sub-band circuit
- Multiple lock functions ■ Wireless remote control function
- Built-in CTCSS encoder & optional TSU-7 decoder
- Date & time display, stopwatch, alarm & on/off timer
- 3-position RF output power control
- Auto power-off with warning beeper ■ Time-out timer
- Separate control & display units (optional cable kits)

KENWOOD COMMUNICATIONS CORPORATION
AMATEUR RADIO PRODUCTS GROUP
P.O. BOX 22745, 2201 East Dominguez St., Long Beach, CA 90801-5745
KENWOOD ELECTRONICS CANADA INC.
6070 Kestrel Road, Mississauga, Ontario L5T 1S8

KENWOOD

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